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OF THE

SECRETARY OF THE NAVY

FOR

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APPENDIX.

REPORT

OF

THE SECRETARY OF THE NAVY.

NAVY DEPARTMENT,
Washington, December 1, 1884.

To the President:

SIR: Of the new unarmored steel cruisers—the Chicago, of 4,500 tons, the Boston and Atlanta, of 3,000 tons each, and the Dolphin, of 1,500 tons—authorized by Congress as an increase of the Navy, only the last has been completed.

The Dolphin is a dispatch-steamer, to be armed with one 6-inch modern rifled gun and six Hotchkiss cannon. Her keel was laid October 15, 1883, and she was launched at Chester, Pa., April 12, 1884. At the preliminary contract trial on November 20, to test the machinery, while at a displacement of 1,279 tons, 221 tons less than the load displacement, she developed a speed of sixteen knots per hour, and an engine-power of 2,141 horses; and she fully meets the expectations of her designers and of the Department. A fracture of her shaft delays the formal acceptance from the contractor. After receiving her armament and stores, she will undergo a further trial in Narragansett Bay, under the system lately adopted by the Department.

The cruisers Boston and Atlanta are well advanced in all their parts. The Atlanta was launched October 9, with a displacement at launching draft of 1,279 tons, and the Boston is ready for launching. The steel boilers of both vessels are completed and the machinery is now being fitted.

The keel of the cruiser Chicago was laid December 15, 1883. Up to November 22, 1884, 1,045 tons of material had been worked into her hull, and she may be considered, in both hull and machinery, as being seven-tenths completed.

The Naval Advisory Board has in the course of its duties inspected and tested about 8,000 tons of mild steel for the new vessels. It has been shown that our steel-makers can readily furnish this excellent structural material in large quantities, and its high quality has been assured by the tests adopted. The experience gained in these tests will, it is hoped, be made of permanent value to the Navy and to the manufacturers through the report of the Board.

The law requiring the ships to be built of steel of great tensile strength and ductility has been complied with, and rigid chemical and physical tests applied to the material, causing much difficulty and delay and extra expense to the contractor, owing to his losses from rejected material, which, as in the case of the broken steel shaft of the Dolphin, was imperfect only because of the inexperience of our steel manufacturers in producing metal of prescribed strength and ductility combined. Patience, forbearance, and liberal treatment of the manufacturers are necessary in order to encourage them to undertake the development of the production in this country of steel plate and armor for naval vessels and ingots for heavy cannon.

The designs for the four cruisers, recommended by the Advisory Board and approved by the Department, were subjected from the beginning to loud and vehement criticism in certain quarters. This was only to be expected. It is rarely that designs of ships for the Government, either in this country or in Europe, escape severe animadversion. In a construction so complex as a modern ship-of-war, involving the application of so many theories based on what are as yet imperfect investigations, it is unavoidable that some diversity of opinion should be found among professional constructors, whether the designs represent progressive or conservative ideas. It is worthy of note that while in this country it was held by some objectors that the ships had too little sail-power, in England they were thought to have too much; and it may be said in general that if all the special points criticised had been altered to meet the views of any single critic, an equally violent opposition to the modified designs would immediately have manifested itself.

The reiteration of objections to the proposed cruisers in newspapers and elsewhere had the effect of disturbing public confidence for a time in the designs. The Naval Committee of the Senate, however, in considering the bill (Senate 698) "to authorize the construction of additional steel vessels for the Navy," was led to make a careful and exhaustive inquiry in reference to the plans adopted by the Department for the vessels then under construction. After having called for and received many oral and written statements from the Secretary of the Navy, the Admiral of the Navy, the members of the Advisory Board, the principal chiefs of bureaus, and other officers, the committee (in their report, No. 161, of February 12, 1884,) arrived at the following conclusion:

"The inquiry developed some difference of opinion upon certain special points connected with the new cruisers, such as the requisite amount of sail-power, the expediency of sheathing the bottom, the beam-engines and the furnaces of the Chicago, and the open forecastle and poop-deck in the Boston and Atlanta, due to the position of the deck-house inclosing the battery.

"While it may be worthy of consideration whether it is desirable to follow the plans adopted for the vessels now under construction in all minute details, about which a diversity of opinion might reasonably be expected to exist among experts, nothing has appeared to show that the

confidence of the Navy Department and of the Advisory Board in the success of these vessels is misplaced."

Continued examination of the subject has confirmed the Department in the opinion that the criticisms advanced against the new ships were either of little moment or based directly upon theories at variance with the progress of modern ship-building. The opinion is further strengthened by an observation of what has been done abroad during the past year. It may be well, however, to consider briefly the validity of the principal objections.

1. The want of full sail-power.

It is now generally admitted that masts and sails are detrimental to the fighting qualities of a naval vessel, and it is mainly on account of their value for purposes of training, and for the sake of economizing coal in time of peace, that they are retained in recent constructions. The British Admiralty has gone so far that it is now building steel cruisers, of which the Mersey and Severn are types, absolutely without masts or sails. In this country the public mind is not yet accustomed to the fact that masts and sails are a source of weakness in action, and it may be expected for some time to come that popular objections will be raised to vessels built without them, on the ground that they form the sole reliance for propulsion in the event of a failure of the machinery. The system now adopted, however, of providing each vessel with twin screws, and with two complete and independent sets of machinery, reduces the chances of a total failure of the mechanical means of propulsion to such an extent as to make it an almost impossible contingency.

2. The absence of sheathing.

In this respect, also, the Advisory Board finds itself in accord with the most distinguished European designers. The three cruisers now building or lately completed at the Elswick Works in England, the Giovanni Bausan, for the Italian Government, and the Arturo Prat and Esmeralda, of about 3,000 tons each, are unsheathed, as are also the cruisers of the Leander and Mersey classes, of about 3,600 tons, eight of which have been laid down by the British Admiralty since 1880. It was decided not to sheathe our new cruisers, on account of the additional cost, the great difficulty of preventing galvanic action between the iron and copper, and the increase, estimated at 12 or 15 per cent., in the weight of hull, and consequent reduction in the efficiency of a ship of given displacement; while, on the other hand, it appears that the steel bottom can be made as serviceable as a copper one, by the use of anti-corrosive paint, which can be kept clean on ordinary service by the ship's divers.

3. The machinery of the Chicago.

It was frequently asserted that the beam-engines and brick furnaces of the Chicago were a more than doubtful experiment, and that the vessel would consequently prove a failure. This assertion is met by

the fact that, in February last, the Louisiana, of the Cromwell line of steamers, a vessel fitted with beam-engines and externally-fired boilers with brick furnaces, made the passage between New York and New Orleans, from wharf to wharf, in five days and fifteen hours, being the fastest passage on record; and that since that date, after certain modifications in her boilers borrowed from the Chicago's design, she has given more economical results, and shown herself to be in these respects a thoroughly satisfactory vessel.

4. The peculiar features of the Boston and Atlanta.

The objections most strenuously urged against these vessels, apart from their rig and consequent reduced sail-power, were, first, that in the absence of topgallant forecastles and poop-decks, their speed would be reduced by forcing their bows into the sea, and that the sea would be likely to roll on board aft, as they ascended into it; and, secondly, that in working ship, no sufficient protection would be afforded to the men who must be on deck in all weathers. It was claimed that a better vessel could have been designed by putting on a topgallant forecastle and poop-deck, and placing the main part of the battery on the open deck, surrounded by high bulwarks in the usual corvette style.

The assertion that the absence of a topgallant forecastle would decrease the speed when running against a head wind and sea hardly requires an answer, for it is well known by seamen that such a result is induced rather than obviated by high upper-works forward, which expose a greater surface to wind and waves as the ship pitches. For this reason the fastest blockade-runners had a low turtle-back forward. The bow of the Boston and Atlanta is sufficiently high for ordinary cruising purposes; while the protection of the men, which in a full sail-power corvette is given by the high forecastle and poop, is fully secured by the central superstructure. Even if there were any weight to the objections, they are offset by the overwhelming advantages of the arrangement in giving an extensive and unobstructed train to the guns, and therefore an increased efficiency in the battery.

Since the design of the Boston and Atlanta was adopted, the Government of Chile has received from the manufacturers, Sir W. G. Armstrong, Mitchell & Co., of Elswick, England, a new steel cruiser, the Esmeralda. This vessel, designed, constructed, armed, and equipped for sea by the foremost ship-building firm in the world, represents the latest development of the type of steam-cruiser, as understood by those who are acknowledged, in experience, judgment, and skill, to occupy the highest place in the profession. In all essential points the design of the Esmeralda presents a striking resemblance to the Boston, and the adoption of the type by the independent action of different designers is not so much a remarkable coincidence as a simultaneous recognition, by high authorities, of the requirements of a modern war steamer, and of the design adapted to fulfill them. Both vessels are unarmored steel cruisers, with protective decks and water-tight subdivisions, and

without wooden or copper sheathing. They have the same dimensions, being 270 feet long, 42 feet beam, and of 3,000 tons displacement. In both, the topgallant forecastle and covered poop have been done away with. The main-deck of the Boston and Atlanta is 10 feet above the water-line at the stem, and that of the Esmeralda is reported to be about 11 feet, while the latter is without the Boston's low bulwark forward. In sail-power the Chilian vessel is considerably below our cruisers, having barely enough to steady her in a seaway.

The battery of the Esmeralda is somewhat heavier than that of the Boston, but its disposition and the arrangement for protecting the guns are such that this difference would probably be counterbalanced in close action.

In general, it may be said that while each vessel presents some special features which give it an advantage over the other, there is a remarkable resemblance between the two models, and certain of the points in favor of the Esmeralda, such as reduced sail-power and twin-screws, are precisely those which the opinion of irresponsible critics has been ready to condemn in some of the designs of the Advisory Board.

It is safe to say that in preparing plans for the new cruisers which it is hoped will be authorized by Congress, any new features of construction which the ingenuity of foreign designers may devise will be immediately considered by the Advisory Board, and will be adopted if they promise any advantages.

Popular criticism of the new cruisers has been principally directed against their lack of extreme speed, and they have been unfavorably compared with the fleetest of those famous North Atlantic passenger steamers which are making such rapid passages between New York and Queenstown. The comparisons are unfair. These latter vessels are from 8,000 to 11,000 tons displacement, 450 to 550 feet in length, developing from 7,000 to 11,000 horse-power, and burning from 150 to 300 tons of coal per day; and their extraordinary speed is attained only by the sacrifice of qualities essential for the purposes of general naval service. Their machinery rises, unprotected, above the water-line, their great draft is an element of obstruction and danger in coast operations, and their length is an obstacle to freedom of maneuvering.

On the other hand, the naval vessels, the Chicago, of only 4,500 tons, and the Boston and the Atlanta, of only 3,000 tons, combine all the necessary qualities of unarmored war ships; they are short and capable of quick maneuvering; their machinery is below the water-line; they have a large coal supply in proportion to their displacement, and are provided with the means of so forcing the consumption of fuel that a high speed can be maintained for a short period, and they will thus be enabled by the use of long-range and machine cannon to overhaul almost any vessel they may fall in with at sea. No armed merchant steamer could withstand them, and they are capable of overtaking ninety-six per cent. of the merchant steamers of the world.

No nation possesses war vessels equal in high-speed endurance to the great passenger-carrying ocean racers; a war vessel which could overtake them must be built like them, and would be unfit for ordinary cruising. If the English Government were to require one for use in war, it would employ one belonging to its subsidized lines. If the United States would have vessels of the same class available for special exigencies, it must follow the English policy, and give substantial encouragement to the construction and maintenance of fast steamships by American companies.

The reasons why it is not advisable for us at this time to construct even one such expensive war vessel are stated by the Advisory Board in its report of October 25, 1883, and contained in the last annual report of the Department, as follows:

"It [the Board] condemns any policy looking to the present construction of cruisers that shall rival in speed the fastest transatlantic steamers. The merchant steamers having this exceptionally high speed comprise less than one-hundredth part of the ocean steam-tonnage of the world, either in number or value, and most of them, in the event of war, would be withdrawn from their ordinary pursuits. In order to match their speed it would be necessary to build vessels with a displacement of at least 11,000 tons, and, while the great draft and dimensions of such vessels would confine their general efficiency within the narrowest limits, they would absorb for their maintenance and management an undue share of the current appropriations and of the existing allowance of seamen. Furthermore, the cost of building and fully equipping one such vessel would be at least $4,000,000, or nearly as much as that of all the seven ships recommended by the Board."

Nevertheless the Department added:

"If, however, it should appear to Congress desirable to construct one vessel in which all other qualities shall be sacrificed to the attainment of the highest possible speed, and to provide for maintaining it in commission, the Department will gladly submit plans and estimates therefor, and the vessel, when completed, will no doubt add to the capabilities of the Navy."

The Chicago, Boston, and Atlanta are presented for exactly what they are worth; of moderate size and cost, well protected, handy, and heavily armed—useful and important parts of a modern naval force. The rates of speed assigned them are based on very conservative calculations of their probable performance, and they will undoubtedly exceed the estimates; but the first unarmored cruisers of the new American fleet are not intended for comparison in speed with unprotected racing ships of enormous size, or in defensive power with modern ironclads.

ARMAMENT OF NEW CRUISERS.

To provide the armament of the new steel cruisers, contracts have been made for steel forgings for eight 8-inch and twenty 6-inch guns. Of those for the latter, which were ordered at the Midvale Steel Works, at Nicetown, Philadelphia, eight sets have been completed and good

progress has been made with the other twelve. The forgings for the 8-inch guns were ordered in England, part from Messrs. Charles Cammell & Co., of Sheffield, and part from Sir Joseph Whitworth & Co., of Manchester. Great delay has been experienced in obtaining some of these forgings, especially those ordered from Sir Joseph Whitworth & Co., and it is still uncertain when they can be expected. There being no plant in this country capable of producing 8-inch forgings, the Government is compelled to wait upon the convenience of foreign manufacturers.

The ordnance machine-shops at the Washington navy-yard, where the work of finishing part of the guns is being done, are now beginning to receive steel forgings in sufficient number to enable the Department to prosecute the work to advantage. One 6-inch gun for the Dolphin has been finished and has had an extended trial and use at the naval ordnance proving-ground at Annapolis, Md. Its performance is very satisfactory.

Contracts have been made for machine-finishing others of the guns with two private firms—the South Boston Iron Works and the West Point Foundry Association.

The former firm has received two sets of 6-inch forgings, and has begun work on them, but it has not yet been possible to furnish any to the West Point Foundry. Owing to the delays and difficulties inseparable from the commencement of a work of such magnitude as the making of steel high-power guns in the United States, the main batteries of the new cruisers, with the exception of a few guns, cannot, under the most favorable circumstances, be completed until some months after the vessels are finished. The secondary batteries and search-light outfits have been ordered and are expected to arrive in time for the vessels.

It should be borne in mind that the manufacture of modern high-power guns, such as are required for the new cruisers, being wholly new in this country, is slow and difficult, and the cost here is necessarily greater than if they were procured abroad.

ARMORED VESSELS.

The armor for the turrets, pilot-houses, and armored stack of the double-turreted monitor Miantonomoh, contracted for with Messrs. John Brown & Co. and Messrs. Charles Cammell & Co. of Sheffield, England, through their agents, Messrs. William H. Wallace & Co., of New York, has been delivered at the New York navy-yard, except one port-plate and the pilot-house plates. The former plate had been rejected, and a new one is now making to replace it. The work of preparing the decks and internal arrangements of the vessel, to accommodate the new roller-base turrets, is well in hand at the New York yard, and the turrets are in course of erection in the iron-plating shop of that yard.

The engines and machinery of the monitors Amphitrite and Terror, now under construction by the Harlan & Hollingsworth Company, of Wilmington, Delaware, and the William Cramp & Sons' Ship and Engine Building Company, of Philadelphia, respectively, under contracts made in pursuance of the act of March 3, 1883, are about one-half completed. The engines and machinery of the monitor Puritan, contracted for under the same act with Mr. John Roach, of New York City, are completed, and ready for trial. No work has been done on the hulls of these vessels, except such as was absolutely necessary to admit and fit the machinery, there being no appropriation for the purpose.

Under the act of Congress "making temporary provision for the naval service," approved July 7, 1884, the unexpended balance of the appropriation of $1,000,000 for engines and machinery for the double-turreted monitors was covered into the Treasury, except such part as might be required under existing contracts for the engines and machinery of the Amphitrite, Terror, and Puritan.

The Department was therefore unable to carry out the intention, expressed in its last annual report, of making a contract for the completion of the engines and machinery of the Monadnock, and her hull now lies at the navy-yard at Mare Island in the same condition as at the date of that report.

The Department renews its previous recommendations that early action be taken by Congress looking to the completion of the monitors. The amounts required are submitted in the formal estimates, as follows:

For completing the four monitors	$3,159,654 62
For ordnance for the same and for the Miantonomoh	1,073,000 00
Total	4,232,654 62

Included in the first amount there is estimated for the side, turret, and other armor, as follows:

Puritan, 1,108 tons, at 21.9 cents per pound	$543,540
Amphitrite, 617.6 tons, at 21.3 cents per pound	294,411
Terror, 617.6 tons, at 21.3 cents per pound	294,411
Monadnock, 617.6 tons, at 21.3 cents per ton	294,411
Total, 2,960.8 tons, at 21.5, costing	1,426,773

If the armor is to be procured within a reasonable period, it must be obtained abroad, like that of the Miantonomoh, since no domestic manufacturers are now prepared to make it, and the amount required for this particular object would not justify them in making the necessary outlay for a plant, even if the Government could wait. If, however, additional armored vessels are to be built, it is desirable that active measures should be taken by the Government to encourage the manu-

facture of armor in this country, in connection with the production of steel ingots for guns.

It has never been claimed for the monitors that they would be a match for the enormous ironclad battle-ships of Europe, costing $4,000,000 each, but they will none the less prove useful and efficient vessels for coast and harbor defense. They have repeatedly been made the subject of examination by naval boards, which have approved their structure and advocated their completion. The highest professional opinion has pronounced in favor of finishing them, and has declared that the total cost, about $1,600,000 for each monitor, will be in no way exorbitant when compared with the results obtained. Common prudence demands that immediate steps should be taken to remedy the defenseless condition of our coasts and harbors, and the most rapid and economical measure which can be adopted at the present time is to push the partly constructed monitors to completion.

ADDITIONAL NEW VESSELS PROPOSED.

The Department, on the 21st of April last, requested the Advisory Board to report concerning the general features and essential requisites of the following vessels, namely, one cruiser of 4,500 tons displacement, one cruiser of 3,000 tons, one dispatch-vessel of 1,500 tons, two heavily armed gunboats of 1,500 tons each, one light gun-boat of 750 tons, one steel ram, one cruising torpedo-boat, two harbor torpedo-boats, and one armored vessel not exceeding 8,500 tons displacement. Of these, all but the last had been made the subject of recommendations in the Department's annual report of December 1, 1883, in general pursuance of recommendations previously made by the two Advisory Boards. It was deemed desirable, in addition, to obtain the opinion of the Board in reference to an armored vessel, in view of the possibility that its construction might be authorized.

A full statement of the plan of the Board will be found in its report, dated November 7, 1884. It recommends for the 3,000-ton cruiser, a single-decked twin-screw vessel with high freeboard, inclined steel deck, and water-tight subdivisions, carrying a battery of four 6 inch and seven 5-inch breech-loading rifled guns and ten Hotchkiss cannon. The design provides for a barque rig, giving two-thirds of full sail-power. The machinery consists of two complete and independent sets of engines and boilers, in water-tight compartments, with an indicated horse-power of 3,500, and calculated to develop a speed of not less than fourteen knots in smooth water, and a maintained sea-speed of thirteen knots.

The two heavily-armed gunboats should be similarly constructed, but with the rig of a hermaphrodite brig, and with horizontal engines of 1,600 indicated horse-power; one carrying a battery of two 8-inch guns mounted on pivots at the ends of a central superstructure, and two

5-inch guns in sponsons; and the other a 10-inch and a 6-inch gun, in place of the two 8-inch guns.

The light cruising gunboat of 800 tons displacement should carry a battery consisting of six low-power 5-inch breech-loading rifled guns. It should have a light hull of mild steel, unsheathed, and a barkentine rig, which, with a single screw, would make the vessel manageable and useful under sail, with a maintained sea-speed of ten knots an hour under ordinary circumstances.

The armed dispatch-boat should be an unprotected vessel of high speed, of the size, motive power, and general description of the Dolphin, but carrying a battery of seventeen Hotchkiss cannon. It is believed by the Board that this armament of high-power guns, with rapid fire, will be more advantageous than a single great gun of relatively slow and inaccurate fire, in view of the speed of modern merchant steamers, with which alone such a vessel would be expected to contend.

For the armored ram the design proposed by the board is that of a handy, short, twin-screw vessel of 3,000 tons displacement and seventeen knots speed, unarmed, with a central citadel to protect the machinery and an under-water protective deck to strengthen the ram, render secure the buoyancy, and cover the steering-gear.

In reference to a cruiser of 4,500 tons the Board, after mature consideration and in the light of recent developments in ship-building, is of the opinion that the essential fighting qualities of such a ship can be obtained at less original and continuing cost in a smaller vessel, and that the only material advantage in greater size is the provision of accommodation for a flag officer and his staff, an advantage not sufficiently urgent at the present time to call for the outlay. In place of a 4,500 ton vessel, therefore, the Board prefers a fast twin-screw cruiser of the type of the Boston and Atlanta, of about 3,600 tons displacement, protected throughout by a steel deck, carrying armor-piercing guns, and with a speed of at least sixteen knots an hour in smooth water, which would exceed considerably that of most ironclads. By the adoption of twin-screws, two independent sets of machinery, and the necessary arrangements for a forced draft the Board considers that the use of sails as a means of propulsion will be rendered unnecessary. If it should be deemed wise to construct a cruiser of larger dimensions, the Board recommends that the Chicago should be duplicated, with certain improvements in minor details.

In regard to torpedo-boats, the Board reports that it found itself called upon at the outset to decide upon the form of torpedo intended to be used, upon which the design of the boats would necessarily depend. It also found that although there are American inventions of considerable promise, the Whitehead torpedo is the only one in existence which has passed through all the experimental stages and is in the market for sale as a completed weapon of war; and, further, that all the torpedo-boats of European nations for naval attack and for coast and harbor

defense are designed for the use of this torpedo alone. The Board therefore recommends, first, that $100,000 be appropriated for the purchase of the right to use the Whitehead torpedo and of a number of completed torpedoes; and, secondly, that $150,000 be appropriated to build by contract one first-class torpedo-boat 130 feet long, one first-class torpedo-boat 110 feet long, and one second-class torpedo-boat 70 feet long, all fitted to carry the Whitehead torpedo; and that the contracts should stipulate a penalty if results equal to those in foreign boats are not obtained, and a premium if they are exceeded.

In regard to an armored vessel, the Board finds that under existing conditions the depth of our harbors and the size of our dry-docks would present serious obstacles to the usefulness of a first-class sea-going battle-ship, that is, a ship armed with the heaviest guns, protected by the heaviest armor, and provided with the maximum engine-power attainable in a vessel of not unwieldy size. Investigation proves that the necessity of being able to enter the principal ports on this coast would limit the maximum draft of such a vessel to twenty-three feet, while the size of the docks at Boston and Norfolk would fix the extreme breadth at fifty-eight feet. The dry-dock now building at Mare Island is the only one in the United States that would admit a first-class ironclad. These conditions would establish a maximum displacement of 7,000 tons, and the preliminary design of an ironclad of such dimensions will shortly be completed.

The Department, in adopting substantially the recommendations of the Board, would call special attention to the necessity of developing the means of attack and defense by torpedo-boats, and the importance of entering in this country upon the construction of what has now become one of the most complicated naval weapons, and yet one of the most inexpensive means of defense—for fifty torpedo-boats may be built for the cost of one ironclad.

Great attention has been paid to the subject in recent years by European States and the construction of torpedo-boats has long since passed the stage at which improvised or hurriedly-built substitutes will take the place of a boat of the most approved modern design. An organized system of coast protection by torpedo-boats is now considered indispensable. They are intended to form a middle line of defense or coast patrol between the forts and fixed mines inshore and the monitors and coast-defense vessels outside. Germany has taken a decided step in advance of other powers in this respect, and will in time, at a final expense of about four million dollars, be in possession of one hundred and fifty of these craft, or one for every ten miles of coast, a distance which can be traversed by the boat in half an hour in any weather in which an ironclad would venture to approach. The United States have hitherto made no progress in this direction, and in view of the overwhelming importance of establishing the middle line of defense, and the opportunity offered by our own coast for utilizing these instruments

of warfare, it is strongly recommended that immediate action be taken to carry out the policy indicated by the Board.

The recommendations made above are in all material points the same as those offered in the Department's report of December 1, 1883, and bear out the views then advanced as to the gradual replacement of our decaying fleet by modern constructions. The first Advisory Board fixed the number of vessels required in commission at forty-three, and the reserve at twenty-seven, making a total of seventy. To provide such a fleet the Department recommends the construction of seven modern cruisers annually, for the period of ten years, at a cost of four millions a year, a large part of which would be saved by abandoning attempts to rebuild the present wooden fleet. Such a plan, while conforming to the conservative demands of our national policy, and affording ample time for adopting every new development in the art of construction, would give the country, at a moderate cost, a Navy adequate to train its officers and to maintain its safety and honor.

THE PRESENT FLEET.

The available cruising war-vessels of the Navy are the following: One first-rate, the Tennessee, of 4,840 tons displacement;

Eleven second-rates, the Trenton, Lancaster, Brooklyn, Pensacola, Richmond, Hartford, Omaha, Lackawanna, Vandalia, Shenandoah, and Powhatan, varying in displacement from 2,100 to 3,980 tons;

And nineteen third-rates, the Juniata, Ossipee, Quinnebaug, Swatara, Galena, Marion, Mohican, Iroquois, Wachusett, Kearsarge, Adams, Alliance, Essex, Enterprise, Nipsic, Yantic, Monocacy, Alert, and Ranger, varying in displacement from 900 to 1,900 tons—making in all thirty-one vessels, of which only the last three, of less than 1,400 tons displacement, have iron hulls, all the others being built of wood.

Of the above list, it is reported that the following will be condemned when surveyed, as they cannot be repaired under the law: Tennessee, Lackawanna, Powhatan, and Wachusett.

The following, it is estimated, will pass out of the service within six years: Brooklyn, Hartford, Iroquois, Kearsarge, Pensacola, and Richmond.

It is thought that the remaining eighteen wooden vessels on the list may, with care, be made to last between ten and fifteen years, making it probable that at the end of that time the only cruising vessels of the present list remaining will be the three small iron vessels, Monocacy, Alert, and Ranger.

Of the available vessels named in the annual report of the Department, dated November 29, 1882, the Alaska, Ticonderoga, Tuscarora, and Wyoming have been stricken off the Navy Register under the acts of August 5, 1882, and March 3, 1883; the Monongahela has been fitted as a storeship; and the Ashuelot has been lost at sea.

Of the vessels on the Navy list at the same date, but not then deemed available, the following have been stricken off under the same acts: Antietam, Benicia, Burlington (formerly a ferry-boat), Canandaigua, Colorado, Colossus (never launched), Congress, Connecticut (never launched), Cyane, Dictator, Florida, Frolic, Guard, Iowa (never in commission), Java (never launched), Kansas, Massachusetts (never launched), Monadnock (old), Narragansett, New Orleans (never launched), Niagara, Nyack, Ohio, Oregon (never launched), Pawnee, Pennsylvania (never launched), Plymouth, Relief, Roanoke, Sabine, Saco, Santee, Savannah, Shawmut, Supply, Susquehanna, Virginia (never launched), and Worcester; and eight tugs: Blue Light, Emerald, Glance, Jean Sands, Phlox, Rose, Seaweed, and Sorrel.

REPAIRS OF WOODEN SHIPS.

It was recommended in the annual report of the Department for 1882 that the wooden vessels should receive only such moderate repairs as would enable them to serve the purpose of the Government until a new modern navy could be constructed, and with this view a continuance was advised of the proviso adopted at the first session of the Forty-seventh Congress, in the naval appropriation act of August 5, 1882, limiting the repairs of wooden vessels to a fixed percentage of their cost, but it was recommended that the limitation be fixed at 20 instead of 30 per cent. This recommendation was adopted in the naval appropriation act of March 3, 1883, passed at the second session of the same Congress.

In the report of December 1, 1883, the Department recommended the continuance of the limitation in the following words: "The proviso of the act of March 3, 1883, limiting the repair of wooden ships to 20 per cent of their cost, should be continued in force in order that no money may be expended in rebuilding worn-out structures of an obsolete type." Notwithstanding this recommendation, in the naval appropriation bill reported from the Committee on Appropriations to the House of Representatives at the first session of the Forty-eighth Congress, which passed the House March 6, 1884, the 30 per cent limit was restored. The Department believes that this is a step backward. The real explanation of the alleged disproportion between the amount of expenditure and the results accomplished in the naval administration of this country is to be found in the adherence to a policy of attempting at great cost to rehabilitate worn-out structures under the name of repairs. For more than two years the Department has combated this wasteful policy, and has shown repeatedly by actual figures to what extravagance it has led. It is only necessary to cite a few instances mentioned in the reply of the Department, January 11, 1884, to a resolution of the Senate (Forty-eighth Congress, first session, Executive Document No. 48).

The Shenandoah, built in 1862, at a cost of $463,866.75, has been charged with repairs since her completion amounting to $906,481.54.

The Ossipee, built in 1861, cost $407,064.20, and her repairs since that time have amounted to $1,197,391.39. The Kearsarge, built in the same year for $286,918, has since been repaired at a cost of $1,123,415.75, enough to have nearly built four new vessels of the same description. The Pinta, which cost in 1865 $135,915.91, has cost for repairs $224,826.52.

It now remains to be seen whether this policy of unlimited repairs which the Department has sought earnestly to check is to be resumed in the future. Its injurious effects are far-reaching and various. It places the whole subject of construction and repair outside of definable limits, and prevents the exercise of the necessary checks. Returns of expenditure, under the vague heads of "labor" and "materials," afford no definite clew to the real application of the moneys expended. "Repair" and "reconstruction," in the absence of fixed limits, are terms easily interchangeable, and the published statements of expenditure under the first name during many years show that it is only too apt to mean the second. The bureaus having the supervision of work at the navy-yards are unrestricted in their expenditures for repairs of ships and engines, except by the gross amount of the annual appropriations. The only pretext upon which the existence of our overgrown establishment could be justified was this demand for annual reconstruction under the fiction of necessary repairs, and hence it is that instead of maintaining such yards and such only as were necessary for the advantage and benefit of our ships, the ships have been made to drag out a protracted existence for the benefit of the yards.

NAVY-YARDS.

The most perplexing question in the reconstruction of the Navy will be the disposition and management of the navy-yards, each having numerous workshops, and each workshop being engaged in producing or refitting separate portions of every one of the naval vessels constructed or repaired, while there are many heads of the work and no one technical superintendent responsible for and supervising the whole.

In pursuance of the policy declared by Congress in the reduction of appropriations for yard maintenance and in providing small sums for the care of closed yards, all work upon ships has been discontinued in several of the navy-yards, as stated in the last annual report, and these are used only as naval stations.

Under the conditions of modern ship-building, not more than two naval workshops should be maintained on the Atlantic coast and one on the Pacific; and it may even be doubted whether more than one is needed on the Atlantic coast. The New London yard should be offered back to the State of Connecticut, and the League Island yard to the city of Philadelphia. The Boston yard, being in the heart of a great city, should be sold or reduced in size. The Pensacola and Portsmouth yards would sell for only a small price, and may well be kept for naval stations and arsenals.

Assuming that the workshops are to be kept open at the New York, Norfolk, and Mare Island yards, certain improvements in administration are indispensable, or any modern ship which may be built in them will be a failure, and any ship built elsewhere which may be sent to them for repairs will be ruined; while both in building and repairing excessive and extravagant expenditures will be made.

First among the necessary improvements is that recommended in the report of last year:

"These establishments must first be thoroughly reorganized in such a way as to exclude all political considerations from their management; otherwise bad and expensive work will be the result. We cannot afford to destroy the speed of our naval engines in order to make votes for a political party. Whatever other governmental agency may be conducted with partisanship, a great naval workshop, dealing with the hull of a modern steel steamship, its fittings and equipment, and with the complexities of its machinery, cannot be successfully so managed."

"Until the navy-yard workshops are managed on business principles and without regard to politics the construction and repair of the new American navy should be committed to those builders who employ or discharge their foremen and all their artisans according to their skill as mechanics and without caring for their political opinions or votes."

These views are in accordance with section 1546 of the Revised Statutes, which declares as follows concerning the employees at the navy-yards:

"Nor shall any workingman be removed or discharged for political opinion."

The foremen should be selected without regard to their ability or influence as ward politicians, and the best and most capable workmen should be employed without regard to their votes or their activity in politics. Unless some plan can be devised, and in good faith carried out, which secures such non-partisan management of the naval workshops, all of them should be closed and all building and repairing of Government vessels should be let to the lowest bidder. The fast steel war-ship of the future cannot be produced or kept in repair under such a system as has too often prevailed in our navy-yards.

Secondly, a plan must be adopted to fix with certainty the direct responsibility of some one person for the performance of the work skillfully, successfully, and economically. The present system has two defects:

The navy-yard is a great naval station with an admiral or commodore in command, surrounded by all the form and ceremony incident to a military post. The mechanical workshops and the officer in charge of them are under his control, and he is supposed to be responsible for what is done. However complete may be the military supervision, the technical oversight of the commander-in-chief is usually merely nominal. Too many persons are in form or in fact connected with the work; too much routine and formality exist; promptness of decision and action

does not prevail; and responsibility for neglect, delays, or failures cannot be definitely fixed.

The next defect is of the same character as that which exists in the organization of the Navy Department itself, namely, the subdivision of the direction of work upon vessels among the naval constructor, the chief engineer, and the equipment officer; all three engaged upon one vessel, all having co-ordinate powers, and none of them under any control on the spot except that of the line-officer of high rank who commands the naval station. Under these circumstances, unity of action and effective direction and superintendence in the building or repairing of a ship are impossible.

The remedy for these defects must be found in placing one technical head—a competent ship-builder—over all the persons engaged in building or repairing the ship; over the work on the hull, the machinery, and the equipment. The difficulty of finding within or without the naval corps persons fit for the service required, and of placing them in their appropriate positions in the naval establishment, is recognized. But they must be found if the Government workshops are to be worthy of the name. When found and installed they must be made in all technical matters practically independent of the commanding officer of the naval station. There can be no objection to the military command of the station exercised by the commandant; but it should be confined to military objects, and the superintendent of the workshop should by the Navy Department be held directly and solely responsible for the work of construction, repair, and equipment under his charge.

There is something radically wrong in a system which unites in a single organism a military post with its routine, its forms and cere-r [illegible] its modes of official correspondence, its quarters for officers, [illegible] its drill grounds and barracks on the one hand, and a mechanical workshop devoted to operations that have not the remotest connection with the discipline of a military service. The organization, the methods of control required, the objects to be accomplished are totally dissimilar and incompatible. It would be wrong to undervalue the importance of military forms and usages and the elaborate but perhaps necessary machinery which is a characteristic feature of military administration; but it is clear that this is not the kind of machinery that belongs to a workshop. At the present time, navy-yard administration is overloaded with traditions and customs, the work is obstructed by a cumbrous organization, technical responsibility is lost in the elaborately graded multitude of semi-technical and semi-military officials; instead of smoothness is to be found friction, instead of promptness delay and procrastination, instead of thrift extravagance, instead of unity of action a mass of discordant interests. And as if one such establishment were not enough of a blunder, the national policy, under the clamor of localities seeking patronage, has multiplied these military

shops and dotted them all over the country, in order that the benefits of wasteful governmental expenditure may be shared by many States.

As a partial remedy for the evils above described it is recommended that there shall be three officers, to be known as Supervising Naval Constructors, to be appointed by the President by and with the advice and consent of the Senate, either from civil life or from the officers of the Navy, to hold their offices until successors are appointed, and if appointed from the Navy to have the relative rank of captain during their period of office. The Supervising Naval Constructors so appointed should have direct charge of all work now falling under the heads of construction, steam-engineering, and equipment, at the three naval workshops, under the supervision of the Chief of the Bureau of Naval Construction, by whom they could and should be held to a rigid accountability for all work carried on at their establishments; while the Chief of the Bureau would be subject to an equally rigid accountability for all their doings.

This reform is believed to be practicable and necessary. If the force of accumulated traditions and the excessive conservatism of the service prevent its adoption, it would be better to discontinue our yards for all working purposes, and not only build but repair our vessels and engines by contract.

SALES OF CONDEMNED SHIPS AND STORES.

In the last annual report the proceeds of the sales of old vessels under the fifth section of the deficiency act of March 3, 1883, were stated at $384,753, and deducting therefrom $29,000, being the price offered for the Niagara (the sale of which was set aside), and adding $24,312 received from the sale May 3, 1884 of the Pawnee, Supply, and Benicia, the total receipts have been $380,065; which were, immediately after the acceptance of the various bids, deposited in the Treasury of the United States, subject only to the official drafts of the Department for lawful purposes; and on the 18th of April, 1884, at the request of the Department, $200,000 of the deposits were formally covered in as miscellaneous receipts, leaving $180,065 subject to draft.

The act provided, as to any condemned vessels which could not properly be sold and which it might become necessary to remove, that "the cost of such removal shall be paid out of the net proceeds derived from the sale of other vessels hereby authorized to be sold."

For reasons stated in a reply of the Department dated June 14, 1884, to a resolution of the House of Representatives (Forty-eighth Congress, first session, Executive Document No. 170), there have been wholly or partly broken up the Connecticut, Oregon, and Pennsylvania, at Boston; the Colossus and Java, at New York; the Massachusetts and Plymouth, at Portsmouth, and the Canandaigua, at Norfolk; the estimated cost of all the work being about $135,396.98, and the estimated value of the metal and other materials to be realized being $100,732.04, or a

probable net loss of $34,664.94. A detailed statement of the account up to November 24, 1884, is transmitted with this report.

The sales of condemned stores and supplies under the second section of the act of August 5, 1882, stated in the report of last year as amounting to about $138,000, appear, on complete returns since received, to have realized, after paying the expenses of sale, the net sum of $133,406.11, of which $127,617.47 was covered into the Treasury as "miscellaneous receipts" under section 3618 of the Revised Statutes, and $5,788.64 was placed to the credit of "ordnance material and small arms," under the act of June 20, 1878. Additional sales have been made amounting to $26,005.68, of which $10,047.87 were received by the paymaster at Rio de Janeiro from the stores disposed of upon giving up the naval storehouse there in September last. Two sunken hulks have been sold at Mare Island recently for about $2,400, and the proceeds will be covered in as miscellaneous receipts.

WAR VESSELS IN COMMISSION.

The North Atlantic Station remained under the command of Rear-Admiral George H. Cooper until June 26, 1884, when he was retired from active service at Portsmouth, N. H., the command being transferred to Acting Rear-Admiral S. B. Luce. On the 20th of September Acting Rear-Admiral Luce was detached at Newport, and Acting Rear-Admiral James E. Jouett succeeded him. The Vandalia was detached and put out of commission October 14, 1884, and the squadron now consists of the Tennessee, flag-ship, Galena, Swatara, Alliance, and Yantic.

The Nipsic, Commander H. B. Seely commanding, is at present the only vessel on the South Atlantic Station, the flag-ship Brooklyn, flying the flag of Rear-Admiral T. S. Phelps, having returned to New York early in October, 1884.

Rear-Admiral A. K. Hughes commanded the force on the Pacific Station until the 8th of April, 1884, when he was retired from active service. Rear-Admiral John H. Upshur succeeded to the command at San Francisco April 8, 1884. The squadron has been decreased by the detachment of the Pensacola, former flag-ship, and the Adams, and increased by the arrival of the Shenandoah and Pinta; the other vessels being the Hartford, flag-ship, Lackawanna, Wachusett, and Iroquois.

The European Station is now commanded by Rear-Admiral Earl English, who relieved Rear-Admiral C. H. Baldwin, at Southampton, England, on the 20th of September, 1884. The vessels are the Lancaster, flag-ship, Kearsarge, and Quinnebaug.

Acting Rear-Admiral John Lee Davis is now in command of the Asiatic Station, having joined December 19, 1883. During the past year the Richmond and Essex have been ordered home, and the squadron has been increased by the arrival of the Trenton, Ossipee, and Alert, which, with the Enterprise, Juniata, Monocacy, and Palos, constitute the present force.

The Powhatan has been engaged in detached service, the Michigan on the lakes, and the Ranger in surveys on the Mexican and Central American coasts of the Pacific.

THE JEANNETTE EXPEDITION.

Lieutenants Giles B. Harber and William H. Schuetze, who had been employed in the continued search for the missing boat's-crew of the Jeannette, and subsequently in executing the orders of the Department issued in pursuance of the act of August 7, 1882, relative to the removal of the remains of Lieutenant-Commander De Long and his companions, remained in Siberia during the summer of 1883, awaiting the return of cold weather, during which alone the transportation could be effected. The bodies in their charge were those of Lieutenant-Commander George W. De Long, Surgeon James M. Ambler, Jerome J. Collins, Walter Lee, Adolph Dressler, Nelse Iverson, Carl A. Görtz, George W. Boyd, Heinrich H. Kaacke, and the cook Ah Sam. They had been removed from the grave in the Lena Delta and placed in temporary sealed cases at Yakutsk.

The sled train with the bodies left Yakutsk November 28, 1883, arriving at Orenburg, the nearest railway point, on January 16, 1884. At the principal cities on the route the train was received with military and civil honors by the local Russian authorities. At Orenburg the remains were taken to the hospital and transferred to the metallic burial cases sent from the United States, after which they were placed in a special car. On January 24, Lieutenants Harber and Schuetze started for Hamburg via Moscow and Berlin, reaching their destination February 2. Similar honors were paid at important points on this journey. At Hamburg the bodies were transferred to the steamer Frisia, of the Hamburg American Packet Company, which sailed for New York February 6, and arrived February 20.

The bodies were landed at Hoboken, N. J., and were conveyed on February 22, in the tug Nina, to the Battery, where they were received with suitable honors. The escort was composed of a detachment of seamen and marines, a battalion of the Regular Army, and two regiments of the National Guard of the State of New York. Funeral services were held at the Church of the Holy Trinity, on Madison avenue, after which seven of the bodies, among them that of Lieutenant-Commander De Long, were buried at Woodlawn Cemetery. The remaining three, being those of Dr. Ambler, Mr. Collins, the meteorologist, and the coal-heaver, Boyd, were delivered to their friends for interment at the places designated by the latter.

THE GREELY RELIEF EXPEDITION.

By Executive order of December 17, 1883, a Board composed of officers of the Army and Navy was constituted to "consider an expedition to be sent for the relief of Lieutenant Greely and his party, com-

prising what is known as the Lady Franklin Bay Expedition, and to recommend to the Secretaries of War and the Navy jointly the steps the Board may consider necessary to be taken for the equipment and transportation of the Relief Expedition, and to suggest such plan for its control and conduct and for the organization of its personnel as may seem to them best adapted to accomplish its purpose." The Board met pursuant to the above order on December 20, and after a full examination of the subject, with the assistance of testimony from all persons having experience in Arctic expeditions whose advice could be obtained, presented a report dated January 22, 1884, which was immediately transmitted to Congress. On the same day a joint resolution making an appropriation for the relief of Lieutenant Greely and his party was introduced in the House of Representatives, which resolution was finally passed and approved February 13, 1884.

It was decided at the outset, in accordance with the opinion of the Secretary of War and the Secretary of the Navy, as expressed in a letter of January 17 to the President, that the control of the expedition should be committed to the Navy Department, and on February 18 Commander Winfield Scott Schley was designated for the command.

In view of the probable passage of the resolution authorizing the expedition and of the extreme urgency of the case preliminary steps were taken to secure suitable vessels. After careful examination of the vessels available for the purpose, on February 2 the steam-whaler Thetis was purchased at Dundee, Scotland, and on January 28 the sealing steamer Bear at St. John's, Newfoundland. The British Government generously presented to the United States for the use of the expedition the steamer Alert, which had previously been thoroughly prepared and equipped for service, and had been successfully employed in the Arctic expedition of 1875–1876 under Sir George Nares.

At the instance of the Secretary of War and the Secretary of the Navy, the Secretary of State caused requests to be addressed to the owners of steam-whalers and sealers abroad to direct the captains of their vessels to be on the watch for traces of the Greely party. The minister of the United States at Copenhagen was also directed to request of the Danish Government that instructions should be issued to the authorities in Greenland to afford all possible facilities to the expedition.

The Bear arrived at New York February 15. The Thetis arrived at the same place, from Dundee, Scotland, March 23, under command of Lieut. L. L. Reamey. The Alert arrived April 22, from Spithead, England, under command of Lieutenant-Commander C. F. Goodrich. Lieut. William H. Emory was assigned to the command of the Bear, and Commander George W. Coffin to that of the Alert, which was to be employed as a reserve vessel. The Thetis was placed under the command of Commander Schley, commanding the expedition.

After careful inspection of the vessels, it was decided to make certain necessary alterations. These alterations, and the supply of the necessary

equipment, were hastened forward with all possible care and dispatch, the chiefs of bureaus giving their personal attention to all the details.

The use of anthracite coal being inexpedient, the coal-transport Ybarra was chartered and brought over from Cardiff 2,000 tons of Welsh coal of superior quality. To supply the expedition in the Arctic regions, a contract was entered into with the agents of the English steamer Loch Garry to transport 500 tons of coal from Cardiff to Littleton Island.

The officers and crew of the vessels were carefully selected after every precaution had been taken to ensure the necessary physical and other qualifications for their arduous duty. In accordance with the plan early decided on, the Bear, whose preparations were most advanced, sailed from New York April 24. The Thetis followed on May 1, and the Alert on May 10. All the vessels were to stop at St. John's for coal. The Bear reached Saint John's May 1, sailed on May 3, and arrived at Godhavn May 13. After several unsuccessful efforts to penetrate the ice barrier, she succeeded in getting through to Upernavik, where she arrived May 28. On the following day she was joined by the Thetis. The collier Loch Garry had previously joined the Thetis at Saint John's, and Ensign Washington I. Chambers was detailed to represent the Government on board and protect its interests, in view of its responsibility for the ship from the time of her sailing from St. John's until her return to that port. The Loch Garry remained in company with the Thetis, and both ships arrived at Godhavn May 22. After leaving this point, on May 24, the same difficulties were encountered in the navigation through the ice barrier that had delayed the progress of the Bear. It was therefore determined to send the Loch Garry back to Godhavn until the weather became more favorable. Two days later the Loch Garry was enabled to come up with the Thetis, and after a passage of great danger and difficulty the two vessels arrived at Upernavik. Here it was ascertained that the condition of the packed and unbroken ice to the northward would render the further progress of the coaling steamer impossible at this date, and she was accordingly directed to remain until the arrival of the Alert.

The Thetis and Bear sailed from Upernavik May 29, Governor Elberg, of Upernavik, accompanying the ships as far as Kingitok, to render assistance. Here the fleet was detained until June 1. From June 7 the ships were delayed for five days at the Duck Islands, watching the vast fields of ice in Melville Bay, in which no lead was visible. On June 14 an advance of 30 miles was made. On the following day another advance was made through dangerous and tortuous leads, and among heavy icebergs, to a position 58 miles southeast of Cape York. At that point land-ice was found to extend in one unbroken and impenetrable mass a distance of 60 miles off shore, while there were unfailing indications of coming southeast gales. During the next two days, until the gale abated, the ships were in imminent peril.

On the 18th the ships arrived at Cape York. Here they were separated, and the search was continued along the coast to the northward. After three days of difficult navigation, following every lead and crack in the ice, by the aid of constant ramming, and by using torpedoes when practicable, the Thetis, on June 21, arrived at Littleton Island. A day was spent in examining the island with its cairns and caches, but no traces of the missing party were found. On the following day the Bear arrived, after an equally difficult and dangerous passage, and the two vessels pushed over to Payer Harbor, arriving at 7.30 in the evening. Search parties were sent ashore, and one of them found, in the cache on Brevoort Island, the first intimation of the situation of Greely and his companions. Losing no time, the vessels passed around the point of Cape Sabine, and reached the wreck camp an hour after the discovery of the record.

At this point were found Lieutenant Greely and the other survivors of the Lady Franklin Bay Expedition, numbering in all seven persons. Their enfeebled condition showed that they had not many hours to live. They were tenderly cared for, and as soon as their strength was sufficiently restored were brought off to the vessels. The bodies of the dead were then removed, as well as all the records and other property belonging to the party.

The object of the Relief Expedition being accomplished, the ships, on the 23d of June, sailed from Payer Harbor, retracing their course through Melville Bay. On the 1st of July, near Sugar Loaf Mountain, the Alert and Loch Garry were discovered beset in the ice-pack. The former vessel had arrived at Upernavik June 13, but had been obliged to remain there until the condition of the ice was favorable to the safe passage of the collier. Between the 19th of June, when they arrived at Upernavik, and the 1st of July, the two vessels had been struggling to cross Melville Bay.

The four vessels now continued their progress homeward, remaining in company as far as the Brown Islands. The Alert was sent on with the Loch Garry, and the Thetis and Bear, after stopping at Upernavik, joined the others on July 5 at Godhavn, where was buried the Eskimo Christiansen, one of those who had perished at Cape Sabine.

On July 9 the four ships left Godhavn, and the Thetis, Bear, and Loch Garry arrived at St. John's July 17. The Alert arrived on the following day. The coaling steamer was on July 21 sent to New York, and on July 26 the ships of the Relief Expedition sailed from St. John's, arriving at Portsmouth August 1. They were received on their arrival by the Secretary of the Navy and by the North Atlantic squadron, commanded by Acting Rear-Admiral Stephen B. Luce. The survivors of the expedition were landed at Portsmouth, and at the same place the body of Winfield S. Jewell, who had been a resident of New Hampshire, was delivered to his friends.

On the 4th of August a civic reception was given to Greely and his

companions, and the officers and men of the relief squadron by the city of Portsmouth. On the following day the relief ships sailed for New York, arriving August 8. The remaining bodies were landed at Governor's Island, and delivered to the authorities of the War Department.

Under the act approved April 17, 1884, a proclamation was issued by the Secretary of the Navy on that day, and duly circulated, offering $25,000 "to be equitably paid or distributed to such ship or ships, person or persons, not in the military or naval service of the United States, as shall discover and rescue, or satisfactorily ascertain the fate" of the Greely Expedition. No claim for this reward has been presented to the Department, none of the whalers which had attempted the rescue having reached a point within one hundred miles of the missing party.

The joint resolution of February 13, 1884, directed the sale of the vessels which might be purchased for the Greely Relief Expedition. The sale has not yet been made, and it is recommended that the Thetis and Bear be retained for surveying vessels, or to cruise in the waters of Alaska, or for use in the training service.

The expenditures and outlays on account of the expedition appear from the books of the Fourth Auditor to have been $762,996.18, a full and detailed account of which will shortly be ready for submission to Congress, as required by the joint resolution authorizing the rescue. The Bear cost $100,000, the Thetis $140,000, and all three of the ships were thoroughly repaired and fitted for cruising and wintering in the Arctic regions, at an expense of about $200,000. The coal and the hire of the Loch Garry cost over $50,000; provisions, about $100,000; clothing, over $60,000; and the pay of the men, who were given special wages and a bonus on their return, amounted to over $50,000. The large expenditure for supplies was required because, although the Thetis sailed from New York on May 1 and entered Portsmouth on the return on August 1, the expedition was fully fitted for a two years' absence, and in case of necessity could have remained three years without suffering. Much of the outfit is of full value for the naval service. No suggested provision for the safety or comfort of the explorers or for the success of the search was omitted because of its cost.

In preparing the Greely Relief Expedition of 1884, there was neither omission, neglect, nor mishap. In conducting it to a successful issue against the warring elements there were manifested unremitting patience and persistency, indomitable will, honorable ambition, and a high sense of duty to their perishing countrymen and comrades of the Army on the part of all its officers and men. Their achievement has reflected high credit and honor upon the American Navy, and their names stand recorded in the General Order No. 321 of August 5, 1884, in which "the Department extends its cordial and earnest congratulations to Commander Schley, commanding the expedition, and to the officers and men of his command, upon the distinguished success of their efforts,

and takes this occasion of publicly commending the courage, zeal, and judgment with which they executed their difficult and dangerous duty."

ORGANIZATION OF THE DEPARTMENT.

It is necessary to call attention once more to the impossibility of properly conducting the business of the Navy Department without further civilian assistance than is now at the command of the Secretary. There should be, in addition to the head of the Department, at least two responsible departmental officers, whose training is that of civil life, and who shall represent the civil authority. These should be an Assistant Secretary and a Solicitor. The technical subjects, which in great number and variety fall under the consideration of the Department, are distributed among eight bureaus and additional offices, whose chiefs must, by law, be officers of the Navy. The task of conducting, in conformity with the laws of Congress and the policy and will of the President, these many military sub-organizations as a harmonious and efficient whole is too great for any single person from civil life, unless aided in the details of business by responsible civil subordinates. The necessary assistance cannot be given by the chief clerk, whose duties at the head of the clerical force are sufficient to occupy fully his attention. A laborious experience of two years and a half forces irresistibly the conclusion that an Assistant Secretary is indispensable for the proper transaction of the business of the Department. If such aid is not provided, Congress should give authority for the appointment of the chiefs of the bureaus from civilians.

THE BUREAUS AND ADVISORY BOARD.

Occasion is gladly taken to state that whatever differences of opinion have arisen concerning the details of the work of the Department, complete personal friendship and harmonious relations have existed between the Secretary, all the chiefs of the bureaus, and the Naval Advisory Board. This condition has contributed largely to whatever success may have been achieved.

It is again recommended that the two Bureaus of Construction and Repair and Steam-Engineering be united as a single Bureau of Naval Construction, to have for its chief the most competent naval architect who can be found, whether among the present officers of the Navy or in civil life; and it is further recommended that the equipment work be transferred from the present bureau to such enlarged Bureau of Construction.

This consolidation would give unity of responsibility and power in the construction of ships and would obviate the necessity of a Naval Advisory Board, which is now by law placed between the Secretary and the Bureaus.

Elsewhere in this report the necessity is argued of one technical superintending head of each Government workshop at the navy-yards.

Even more indispensable will be found one technical head of the construction offices of the Department which are to design the ships and to supervise their construction, whether in private or public shops. The Secretary, the Chief Constructor, the Engineer-in-Chief, the Chiefs of the Ordnance and Equipment Bureaus, and the Advisory Board, twelve persons in all, have managed to agree fairly well concerning the designs and the work upon the new cruisers, but this extreme distribution ot functions will not answer as a permanent organization.

If one technical head, who shall be the superior of all the constructors, engineers, and other officers engaged in designing ships can be found, he is the proper adjunct of the Secretary. The present naval corps will probably furnish the expert officer; if not, he should be looked for and found in civil life.

BUREAU OF YARDS AND DOCKS.

The annual report of Rear-Admiral Edward T. Nichols, Chief of the Bureau of Yards and Docks, which has been most faithfully and ably conducted during his whole term of office, describes the condition of each navy-yard, and submits estimates, in addition to those for general maintenance and ordinary repairs and preservation, of $3,799,865.29 for permanent improvements. Of this amount the Department has submitted to Congress, through the Secretary of the Treasury, only $733,883, believing, as stated in the report of last year, that, before making any considerable appropriations for permanent improvements, Congress should adopt a definite and complete plan, determining what yards shall be used for construction and repair and how they shall be improved.

The navy-yard system has already been discussed and the opinion expressed that if naval vessels are to be built or repaired in the Government workshops, the latter should be thoroughly reorganized, politics excluded therefrom, and a single technical superintendent provided for each; and that not more than two workshops should be maintained on the Atlantic and one on the Pacific coast.

The Department still continues to recommend the sale of fifty-three acres of the New York navy-yard, together with the naval hospital grounds.

BUREAU OF EQUIPMENT AND RECRUITING.

The late Chief of this Bureau, Rear-Admiral Earl English, resigned his office on the 5th day of September, to take command of the European Station, and was succeeded on the next day by Commodore Winfield Scott Schley, whose report narrates the operations of the Bureau during the past year, in purchasing coal and manufacturing cordage, iron cables, galleys, and sails; considers the training-ships and the apprentice training system and their necessities, and makes certain recommendations concerning needed improvements in the condition of the apprentices and enlisted men of the Navy, which should be specially commended to Congress.

By Executive order dated November 5, 1883, the pay of the petty officers and enlisted men of the Navy was increased, the increase to take effect January 1, 1884, under the authority of section 1569 of the Revised Statutes, which is as follows: "The pay to be allowed to petty officers, excepting mates, and the pay and bounty upon enlistment of seamen, ordinary seamen, firemen, and coal-heavers, in the naval service, shall be fixed by the President."

The changes in the more important ratings are as follows:

	Old rate.	New rate.
Seaman	$21 50	$24 00
Ordinary seaman	17 50	19 00
Landsman	15 50	16 00
Machinist (or corresponding rating):		
First class	50 00	70 00
Second class	50 00	60 00
Third class	50 00	50 00
Fireman:		
First class	31 50	35 00
Second class	26 50	30 00
Coal-heaver	21 50	22 00

BUREAU OF NAVIGATION.

The report of Commodore John G. Walker, Chief of the Bureau of Navigation, describes the operations of the Bureau and the offices under it, in connection with the repair, inspection, and testing of Navy compasses; the investigation of the magnetism of iron and steel vessels, and in particular of that of the new cruisers; the continuation of the determination of longitudes, under the direction of Lieutenant-Commander Charles H. Davis; navigation supplies; ships' libraries; the Naval Observatory; the Hydrographic Office; and the Nautical Almanac.

The Bureau has now procured the necessary instruments for the compass-testing house, and it is desirable that the appropriation for its erection which was approved by both houses in the naval appropriation bill at the last session, but which failed to become a law, should be made without delay.

During the years subsequent to the war the Bureau depended in part for the necessary navigation supplies for the Navy upon articles accumulated during the war. As these supplies are now exhausted, the reduction of appropriation made in the recent acts has subjected the Bureau to great embarrassment. It is, therefore, recommended that the appropriation be increased to $130,000, the amount asked for in the annual estimates, as the lowest sum necessary for a proper administration of the Bureau.

NAVAL OBSERVATORY.

The report of the Superintendent of the Naval Observatory, Commodore Samuel R. Franklin, treats in detail of the work performed at the Observatory with the several instruments, the transmission of time-signals, and the reduction of the observations of the transit of Venus.

It is recommended that the appropriation for printing the publications of the Observatory be increased, and that provision be made for the construction of new buildings upon the site selected and purchased for this purpose.

HYDROGRAPHIC OFFICE.

The Hydrographic Office, ably conducted by Commander John R. Bartlett, has continued to do most efficient work in the correction of charts, the production of new charts from surveys by officers of the Navy, and the preparation and publication of nautical information. Over one thousand announcements have been issued, in the "Notices to Mariners," of which 310,000 copies have been distributed gratuitously in all parts of the world. Light-lists of the world, corrected to July 1, were issued July 20. The branch offices, the establishment of which was noticed in the last annual report, have been of incalculable service in furthering the operations of the office, by giving increased facilities for the receipt and dissemination of maritime information. The monthly Pilot Chart of the North Atlantic Ocean, first issued on December 1 of last year, in continuation of the plan proposed and begun by Lieutenant Maury, has been regularly published since that date, and has met with a steadily increasing demand.

The surveys of foreign coasts by vessels of the Navy are still in progress, and the charts which have been published by the Hydrographic Office from the surveys hitherto made are evidence of the excellence of the work done by naval officers in this field.

PUBLICATION OF THE NAVAL WAR RECORDS.

The preparation for publication of the naval records of the war progresses as rapidly as possible with the limited clerical force provided. In view of the importance of completing this work before the documents in private hands are lost or destroyed, it is recommended that the appropriation for clerks and copyists be increased, and that provision be made for the employment of an agent for the collection of Confederate documents.

BUREAU OF ORDNANCE.

The report of Commodore Montgomery Sicard, Chief of the Bureau of Ordnance, fully relates the operations of this important Bureau during the year, covering the work upon the armament of the new cruisers already referred to; the construction and testing of type guns and carriages at the proving ground at Annapolis, including a modern 6-inch gun, Hotchkiss and Gatling guns, and small-arms; the progress towards testing deflective turrets; the manufacture of a wire-wound gun; tests of projectiles; experiments with dynamite and gun-cotton; unsuccessful efforts to discover, for purchase under the act of

March 3, 1883, an American torpedo adapted to naval warfare; and the development of gun-cotton torpedoes and of torpedo material at the Torpedo Station at Newport, R. I., and the instruction there given to naval officers. The report advocates the purchase abroad of one swift torpedo-boat and a certain number of Whitehead torpedoes, and the selection of a new long-range naval ordnance proving ground, the present one being restricted in its use and dangerous.

GUN-FOUNDRY BOARD.

The Gun-Foundry Board, appointed by the President April 2, 1883, in pursuance of the naval appropriation act of March 3, 1883, after having visited Europe for the purpose of fully observing foreign methods of producing heavy guns, presented its report on February 16, 1884. The report was transmitted to Congress by the President with a message dated February 18, 1884.

The report contains complete and authoritative information as to the condition of artillery and the sources of supply in the United States, England, France, Germany, and Russia, a comprehensive statement as to the manufacture of armor for vessels, and the recommendations of the Board on the subjects referred to in the act under which it was convened, namely, which of the navy-yards or arsenals owned by the Government has the best location and is best adapted for the establishment of a Government foundry, or what other method, if any, should be adopted for the manufacture of heavy ordnance adapted to modern warfare, for the use of the Army and Navy of the United States, and the cost of all buildings, tools, and implements necessary to be used in the manufacture thereof, including the cost of a steam hammer or apparatus of sufficient size for the manufacture of the heaviest guns.

The Board recommends that the gun material should be purchased from our own steel manufacturers, and that two gun factories should be established under the control of the Government—one for the Army, at the Watervliet Arsenal, West Troy, N. Y., and one for the Navy at the Washington navy-yard, District of Columbia, for the assembling of the parts and final fabrication of the guns.

The Board considers that every inducement should be offered to attract the private industries of the country to the aid of the Government in providing ordnance for the Army and Navy, and recommends that a sum of money should be fixed as a permanent yearly appropriation to be expended for this purpose, being satisfied that, with such a guarantee against loss, the required material will be produced by our own private steel works.

The report received favorable consideration in Congress, although no final legislative action was taken upon it, and the Board was reconvened by joint order of the Secretary of War and of the Secretary of the Navy, April 29, 1884, and directed to report in what annual installments appropriations could most economically be made for the provision of

modern ordnance, and to prepare plans and estimates for the preparation and purchase of plant for gun factories to complete guns for the Army and Navy, from 6-inch caliber to 16-inch caliber, including buildings and shrinking-pits.

The Board has been actively engaged in carrying out these instructions, and has nearly completed its report, containing plans and estimates in detail for the two gun-factories. After careful inquiry, it has obtained information which indicates that there are responsible steel manufacturers in this country who, although not provided at present with the necessary plant, are willing to construct the same, and to make bids for contracts with the Government for the supply of the requisite material for the heaviest guns adapted to modern warfare, if a guaranteed order of sufficient magnitude, accompanied by a positive appropriation extending over a series of years, should be made by Congress.

All doubts as to the feasibility of the plan being thus removed, the Department urges that early action be taken to provide means for the construction of modern ordnance within the territory of the United States.

BUREAU OF CONSTRUCTION AND REPAIR.

The report of Chief Constructor Theodore D. Wilson describes the Mohican, just finished at Mare Island; recommends the completion of the New York at the Brooklyn navy-yard; reports the progress of work on the Miantonomoh; urges prompt action for the completion of the other monitors, the preparation of the navy-yards for building steel armored and unarmored vessels, and the construction in the yards of at least half the number of any new ships; calls attention to the want of sufficient Government docks, and otherwise narrates the work of the Bureau and makes statements and recommendations concerning the same.

The Department is convinced of the value of experimental works for determining the resistance of ships by towing models, and that great assistance would be derived therefrom in designing high-speed vessels for the Navy and commercial marine.

BUREAU OF STEAM-ENGINEERING.

Engineer-in-Chief Charles H. Loring, in the first annual report made by him, exhibits the general operations of his Bureau for the year, giving the character and the cost for labor and materials of the work done on the engines of each ship; states the present condition of the machinery of all the naval vessels and the progress of the work upon the machinery of the double-turreted monitors; recommends the completion of the New York; considers the condition of the navy-yards with reference to engineering work; discusses the personnel of the Engineer Corps, advising the repeal of that portion of the law of August 5, 1882,

which reduces the number of passed assistant and assistant engineers to one hundred, and asking that the number may be fixed at one hundred and sixty; and calls attention to the previous recommendations of the Bureau and the Department in favor of increasing the pay of the passed assistant engineers.

BUREAU OF PROVISIONS AND CLOTHING.

Paymaster-General Joseph A. Smith reports the details of the expenditures of his Bureau; describes the improved methods of manufacturing clothing; and states the conclusions of the Navy Ration Board, consisting of Rear-Admiral Earl English, Medical Director Philip S. Wales, the Paymaster-General, Commander H. C. Taylor, and Lieut. T. B. M. Mason, which reported May 27, 1884, concerning desirable changes in the ration, which were carried into effect, so far as they were deemed admissible under existing law, by the Navy Ration Regulations, approved November 15, 1884. The Paymaster-General recommends needed changes in the method of purchasing provisions and of preparing and cooking food on board the vessels of the Navy; discusses the method of commuting rations; states the work of the Bureau in fitting out the Greely Relief Expedition; recommends that the Army practice of selling commissary stores to officers and enlisted men may be extended to the Navy; and urges an increase of pay to passed assistant and assistant paymasters during their third and fourth terms of five years' service, on account of the slowness of promotion pending the reduction of the corps required by the act of August 5, 1882.

The Paymaster-General also calls attention to the recent requirement of the Department that the property accounts of the Marine Corps shall be rendered to his Bureau and to the Bureau of Ordnance. To this end Regulation Circulars Nos. 39 and 40, dated October 6 and October 10, respectively, were issued after careful consideration and consultation with the Fourth Auditor and Second Comptroller of the Treasury.

Another subject to which the Paymaster General asks attention is the payment of naval claims by the Department in accordance with section 3676, Revised Statutes. Section 273 of the Revised Statutes, which confers and defines the powers of the Second Comptroller in relation to naval accounts, makes it his duty "to examine all accounts settled by the Second, Third, and Fourth Auditors, and certify the balances arising thereon to the Secretary of the Department in which the expenditure has been incurred." In the opinion of the Second Comptroller "this explicit language puts it beyond question that the Comptroller is required to certify the balances to the Secretary of the proper Department in every case in which he is required to examine an account, and the Comptroller's duty in regard to an account of this kind is not performed until the balance is certified to the head of the proper Department."

The Fourth Auditor, in a letter to the Department dated December 7, 1883, presented certain objections to transmitting the certificates of settlements to the Secretary of the Navy, none of which objections were based upon any statute.

The Department concurred in the opinion expressed by the Second Comptroller, and in accordance therewith certificates of settled claims are now sent to this Department to be registered and transmitted directly to the persons entitled to receive the money thereon, instead of being sent to them by the Fourth Auditor, as formerly.

The clause in section 3622, Revised Statutes, requiring disbursing officers of the Navy to forward their accounts and vouchers direct to the proper accounting officers of the Treasury, forms an exception to the general provisions of law respecting all other officers or agents of the United States. It does not restrain the heads of Departments from requiring other returns, or duplicate accounts, but it is hardly practicable on vessels at sea to prepare elaborate pay-rolls and other returns in duplicate, in time for them to be reviewed in this Department before settlement at the Treasury. The law should be so changed as to require all returns to be first sent to the Navy Department for preliminary examination and transmission to the accounting officers.

BUREAU OF MEDICINE AND SURGERY.

It appears by the report of Surgeon General Francis M. Gunnell, that the ratio of mortality for the year 1883 was 4.55 per thousand of the naval force, being a slight increase over the average mortality of previous years—the mean death rate for the last fifteen years having been 4.40 per thousand—notwithstanding there has been an absence this year of any epidemic influences tending to increase the ratio.

The report states the condition of the several hospitals, and expresses the opinion that none of them should be sold. In order to remove the naval quarantine station from Portsmouth, N. H., a transfer has been received from the Light-House Board of Widow's Island, in Penobscot Bay, which at slight expense can be made a safe and convenient resort for any ship which may happen to come from an infected port.

The Museum of Hygiene is commended to attention, and allusion is made to the medical work in the Greely Relief Expedition. The report refers to the method in force for many years of collecting and publishing statistics concerning the health of the Navy, and the character and distribution of its diseases in all parts of the world, states the effect of the system in arousing interest in the pursuit of professional subjects and in developing the faculties of observation and research in sanitary science, and advocates a post-graduate course of study for younger medical officers at the great medical centers of New York, Boston, and Philadelphia.

The Department has to report the discovery of frauds in this Bureau practiced by means of false vouchers for goods never delivered. Sus-

picion was aroused about the first of January last, and some inquiries were instituted without any disclosure. The term of service of the chief of the Bureau, Surgeon-General Philip S. Wales, was to expire January 25, and it was determined to investigate more fully after he should retire from office. The extraordinary importunities in his behalf from forty Senators and thirty-one members of the House of Representatives delayed the selection, confirmation, and induction of his successor until April 1, shortly after which the first tangible evidence of fraud came to light, fixing the guilt upon Daniel Carrigan, chief clerk, who had been excluded from his place directly after Surgeon-General Wales left, and upon Edwin C. Kirkwood, clerk in charge of accounts. Steps were immediately taken by the United States district attorney to punish the guilty parties. Kirkwood and many of the contractors were arrested, indicted, and are now being tried. Carrigan absconded and has not been found. A court of inquiry was duly ordered to ascertain and report the extent of the frauds, and thorough measures were taken to ascertain whether any similar frauds had been practiced in other Bureaus, but none such have been disclosed, and there is no sufficient reason for believing that they have existed. The amount of suspected vouchers is $124,835.25, extending over a period from 1876 to 1884, but some portion of the goods paid for was actually delivered, so that the loss is less than the above sum, but the exact amount is not yet ascertained. It appears that Surgeon-General Wales was exceedingly negligent, and that he trusted completely the two clerks and recklessly signed whatever papers they placed before him. The frauds were made possible not by any defect of system, but by a studied neglect on the part of the chief of the Bureau to require, before signing vouchers, the customary evidence from a proper inspecting officer that the goods had been received.

By section 420 of the Revised Statutes the chiefs of the Bureaus are invested with all the authority of the Secretary of the Navy concerning their respective duties; and all moneys are disbursed through the Bureaus without the submission to the Secretary of the bills or vouchers issued. Surgeon-General Wales had, therefore, by statute, the fullest possible power over the funds of his Bureau; no formality in the ordinary routine of the Department would have promptly detected frauds in vouchers regularly issued under his signature, and except the dishonest clerks whom he so implicitly trusted no person in the Navy Department but himself seems blamable for the frauds. No prior suspicion of negligence on his part could have been justly attached to him in view of the high character which he had borne and which led so many eminent public men to confidently certify that he had for four years administered the affairs of his Bureau with signal ability and success, and to persistently urge his reappointment.

Undoubtedly the frauds in the Bureau of Medicine and Surgery were made easier by the frequency with which the "exigency clause," so called, under which purchases are made without advertising, was

used by Surgeon-General Wales. On the 10th of December, 1883, the attention of all the chiefs of Bureaus was by the Department especially called to Sections 3709, 3718, and 3722 of the Revised Statutes, which require all purchases by contracts for supplies and services to be made by advertising, except when a public exigency exists, prescribe the mode of advertising for supplies and contracts, and direct that no person shall be received as a contractor "who is not a manufacturer or regular dealer in the articles which he offers to supply"; and they were informed that a person to be a regular dealer, within the meaning of the law, must be regularly engaged in the business of buying the articles and selling the same to the general public, and not merely engaged in the business of selling such articles to the Navy Department; and they were instructed to conform strictly to the provisions of the above statutes and to require conformity thereto from all persons acting under their command or direction.

On the 4th of February, 1884, the chiefs of Bureaus were also informed that there was no rule of the Department allowing purchases to be made in violation of Sections 3709, 3718, and 3722, where the amount did not exceed $500, because if any such definite rule were to be adopted, then by splitting up orders, the law could be effectually nullified.

On the 3d of July, 1884, the Fourth Auditor called the attention of the Department to the large quantity of supplies procured for the Navy Department under open purchase, and to the necessity of some changes in the methods and forms pertaining to the accounts and blanks in use for Bureau purchases, those chiefly in use being insufficient and dangerous because bearing only the signature of the chief of the Bureau and no subordinate signatures showing the receipt of the supplies. On the 12th of July, the chiefs of the Bureaus were informed of the views of the Fourth Auditor, and were instructed as follows:

"It does not seem that the public exigencies could have required so large a proportion of open purchases. After having given the subject renewed attention you will arrange to conduct your official business in strict accordance with law and regulation, and will correct any erroneous practices which may have prevailed. No departure from legal requirements can be justified by pleading old usage or the custom of your predecessors in office. The law must be your only guide, and you must accept personal responsibility for the performance of duty in strict accordance therewith."

They were also directed at an early date to ascertain the opinions of the Fourth Auditor, and also to confer with the Second Comptroller, with a view to the adoption of the best and safest possible forms to be issued for vouchers for disbursements, in accordance with section 273 of the Revised Statutes; and the Second Comptroller was also asked to confer with the chiefs of the Bureaus and to revise all forms in use,

and to recommend any change deemed by him advisable. Copies of this correspondence are herewith transmitted.

If perfect integrity and fidelity could be relied upon in purchasing-agents, the method of open purchase would be most beneficial to the Government, both in the prices and the quality of the supplies procured, and the many difficulties attending purchases after advertisement, from the lowest bidder, would be avoided. But the wise policy of the law prescribes the latter method except in actual exigencies.

In practice it is frequently difficult to decide who is a regular dealer within the meaning of the statute, and a class of bidders have come into existence whose whole business is bidding for Government contracts and furnishing supplies to the Government on open purchase. The only way to break up such a system is to make awards to higher bidders who are unquestionably regular dealers; and this has been done in some cases. If the law is not a good one it should be repealed; while it remains on the statute book it should be enforced.

MARINE CORPS.

The report of Col. C. G. McCawley, commandant of the Marine Corps, is referred to for the condition of this well-conducted military force. The commandant recommends that appropriations be made for a larger number than 1,500 of the 2,500 privates authorized by present law, and for the 30 second lieutenants also now authorized by law; that better quarters be provided for officers and men at Norfolk; and that some measure be adopted for expediting promotions to the higher grades.

These requests are concurred in by the Department, and the recommendation renewed that Section 1601 of the Revised Statutes be restored, so as to give to the commanding officer the former rank of brigadier-general.

THE NAVAL ACADEMY.

The Naval Academy continues under the command of Capt. Francis M. Ramsay, Superintendent, whose management of the institution is in every way to be commended. His annual report describes the summer practice cruises of the first, third, and fourth classes in the sailing ships Constellation and Dale, and the mechanical work of the cadets of the second class, who were retained at Annapolis; states the number of candidates who failed or were admitted as cadets during the year, and recommends that section 1514 of the Revised Statutes shall be so modified that hereafter all nominations of cadets shall be made on March 5, and that candidates for admission shall present themselves for examination between the 15th of May and the 1st of June; and, also, that the selection of cadets who are to become officers of the Navy to fill vacancies shall be made upon the completion of the four years' rather than at the end of the six years' course.

The recommendations of the Superintendent are concurred in. It is also deserving of consideration whether the nominations of cadets to

the Naval Academy should not be made, like those to the Military Academy at West Point, one year in advance of entry, thus giving the candidates an opportunity to perfect themselves in those elementary studies in which they are examined prior to admission, and which they have no time to pursue during their four years' course.

The present excellent condition of the Academy is largely owing to the policy adopted by the Department of a strict observance of all laws concerning the Academy, as construed by the Attorney-General, and of absolute non-interference with the Superintendent in enforcing discipline and with the decisions of the Academic Board in the cases of cadets found deficient in their studies.

The schoolmaster's duty must be performed by the Superintendent and other instructors. The interposition of the Department, at the solicitation of the friends of cadets, which has at times been frequent, is in a high degree injurious. It has been of late absolutely avoided with the most beneficial results.

Of the cadets who completed their six years' course and finally graduated in 1884, four were appointed as assistant engineers, five as second lieutenants in the Marine Corps, and sixteen as ensigns, all selected in order of merit, under the act of August 5, 1882; and the remaining seventeen surplus graduates were granted their certificates of graduation, honorable discharges, and one year's sea-pay, as authorized by law.

The report of the Board of Visitors, dated June 7, 1884, recommends that provision should be made for subjecting the cadets to the operation of all naval laws while at the Academy; that the decision of the Academic Board dismissing cadets for misconduct be made absolute and final; and that the appointment of cadets be made a year before the time of intended admission.

The report considers the expediency of making the period of study five years instead of four, and states that "no change is desirable in the present standard of scholarship, whether for admission or for subsequent graduation."

The Board reports the buildings and grounds to be in proper sanitary condition, but recommends the acquisition of a small piece of land needed to connect the Academy grounds with those of the Naval Hospital, which latter should not be parted with, and advises the erection of new quarters for cadets and the completion of the house of the superintendent. It also suggests that the law as to the Board of Visitors should be amended to classify its members so that their positions may be held for two or three years in succession.

Several members of the Board express the opinion, stating the reasons upon which it is based, that the present method of appointing cadets to the Academy should be changed, and that candidates should be subjected to open competitive examinations within the Congressional districts.

REPORT OF THE ADMIRAL OF THE NAVY.

The report of the admiral presents certain views in reference to naval expenditures during the past fifteen years, and offers valuable suggestions on the subject of the reconstruction of the Navy. Among modern vessels he especially commends the type of the Esmeralda, with certain modifications. He advises the completion of the monitors, the construction of the seven vessels recommended in the report of the Department of last year, and again in this, and dwells strongly upon the necessity of gunboats and torpedo-boats. He also suggests the construction of a sea-going ironclad, and of four heavy monitors, and presents the plans which he recommends for adoption in the construction of the 900-ton gunboat, estimates for which have been submitted by the Department.

EXPENDITURES.

The appropriations originally available for the year ending June 30, 1884, excluding the sum of $59,813 drawn from the Navy Pension Fund for the support of the Naval Asylum, amounted to $14,145,434.23.

The following statement gives a comparison between the appropriations and expenditures for the year ending June 30, 1884, as shown on that date:

APPROPRIATIONS FOR FISCAL YEAR ENDING JUNE 30, 1884.

Appropriations originally available	$14,145,434 23
Urgent deficiency appropriation, act of May 1, 1884	254,000 00
Balance of appropriation of 1883 for steel rifled breech-loading guns, reappropriated March 3, 1883	83,265 00
Balance June 30, 1883, of appropriations of 1883 for pay of the Navy and pay of the Marine Corps (continuous)	2,266,740 82
Gross amount available	16,749,440 05
Deduct amount due general account of advances	818,668 31
Net amount available	15,930,771 74
Amount drawn from the Treasury under appropriations for 1884	14,315,623 26
Balance on June 30, 1884	1,615,148 48

The item of $14,315,623.26 stated above is the amount drawn by warrants from the Treasury between July 1, 1883, and June 30, 1884, less the amount refunded during the same period. A part of this amount, namely, $1,203,016.32, was in the hands of disbursing officers and agents at the latter date, as stated by the Fourth Auditor.

TOTAL EXPENDITURES DURING THE FISCAL YEAR ENDING JUNE 30, 1884.

Under appropriations of 1884	$14,315,623 26
Under appropriations of 1883	487,564 61
Under appropriations of 1882	26,221 76
Under continuous appropriations	2,463,198 24
	17,292,607 87
Less amount refunded from appropriation 1883–'84	6 43
Total expenditures during fiscal year ending June 30, 1884	17,292,601 44

APPROPRIATIONS FOR THE CURRENT FISCAL YEAR.

Available appropriations for six months ending December 31, 1884		$7,255,283 48
Drawn by warrant from July 1 to November 1	$5,671,521 60	
Refunded during same period	1,288,276 67	
Actual expenditures		4,383,244 93
Being $612,283.15 less than was expended during the same period of last year, and leaving available November 1, 1884		2,872,038 55

ESTIMATES.

The estimates for the fiscal year ending June 30, 1886, are—

Pay of the Navy	$6,955,780 00
Pay, miscellaneous	350,000 00
Coal, hemp, and equipment	931,000 00
Ordnance and torpedo corps	987,715 00
Pay of civil establishments of navy-yards	143,986 25
Navigation work and ocean surveys	192,000 00
Repairs and preservation of vessels, under Construction Bureau	1,750,000 00
Steam machinery	1,000,000 00
Provisions for the Navy	1,275,840 62
Medical Department	60,000 00
Repairs of hospitals	20,000 00
Naval hospital fund	30,000 00
Naval Academy	186,025 45
Contingent expenses of Department and Bureaus	241,000 00
Naval Asylum, Philadelphia	98,111 00
Maintenance of navy-yards	425,289 00
Support of Marine Corps	935,690 56
Making for the ordinary purposes of the service	15,582,437 88

PUBLIC WORKS.

New Naval Observatory	586,138 00
Repairs and preservation of navy-yards	838,200 00
Improvements of navy-yards	733,883 00
Naval Training Station, Coasters' Harbor Island, Rhode Island	60,000 00
Total for ordinary purposes and public works	17,800,658 88

INCREASE OF THE NAVY.

For completion of double-turreted monitors:		
Armored hulls	$2,923,654 62	
Engines for Monadnock	206,000 00	
Navigation outfit	30,000 00	
Ordnance	1,073,000 00	
		$4,232,654 62
One cruiser of 4,500 tons displacement	1,125,000 00	
One cruiser of 3,000 tons	825,000 00	
One dispatch vessel of 1,500 tons	475,000 00	
Two heavily armed gunboats of 1,500 tons each	912,000 00	
One light gunboat of 750 tons	263,000 00	
One gunboat of 900 tons	298,000 00	
One steel ram	515,000 00	

One cruising torpedo-boat	$72,000 00	
Two harbor torpedo-boats	57,000 00	
	4,542,000 00	
Ordnance for new cruisers and gunboats	2,001,918 00	
		$6,543,918 00
One armored vessel of 8,500 tons		2,900,000 00
Two auxiliary steam barques for training squadron		345,000 00
For completion of New York		590,000 00
Steel rifled breech-loading guns		310,000 00
Tools for navy-yards for Bureau of Construction		150,000 00
Making for the increase of the Navy		15,071,572 62

If the 20 per cent limitation upon the repairs of wooden vessels is to be retained, as recommended by the Department, the appropriations for repairs and preservation of vessels and for steam-machinery may be reduced to one-half the amounts above estimated.

If authority be given by Congress for the completion of the monitors, at the estimated cost of $4,232,654.62, and the construction of the new steel war vessels at $9,443,918, the sums which it would be desirable to appropriate for use during the next fiscal year are as follows:

Monitors: Armored hulls, one-half		$1,461,827 31
Monadnock's engines, all		206,000 00
Ordnance, one-half		536,500 00
Total		2,204,327 31
Cruiser of 4,500 tons, two-thirds	$750,000 00	
Cruiser of 3,000 tons, two-thirds	550,000 00	
Dispatch vessel of 1,500 tons, all	475,000 00	
Heavily-armed gunboats, all	912,000 00	
Light gunboat, all	263,000 00	
Gunboat of 900 tons, all	298,000 00	
Steel ram, one-half	257,500 00	
Cruising torpedo-boat, all	72,000 00	
Harbor torpedo-boats, all	57,000 00	
		3,634,500 00
Ordnance for new cruisers and gunboats, one-half		1,000,959 00
Armored vessel, one-third		966,666 67
Grand total		7,806,452 98

COAST DEFENSES AND COALING STATIONS.

The Department renews the recommendation, made in the report of last year, that as an important measure of national defense an interior line of water-ways should be constructed from the Gulf of Mexico to the Massachusetts coast.

The question of providing coaling stations abroad, also there referred to with specific recommendations, becomes year by year more important and pressing. Any well-considered scheme of naval defense requires that this ordinary and obvious precaution should be taken. Whether our cruisers have full sail-power or not, they will still require

frequent supplies of coal at distant points. If they attempt, in default of the necessary coaling stations, to cruise under sail alone, their offensive power will be reduced to the lowest limit, and they will themselves become the prey of vessels of one-third their size, approaching under steam. The Department therefore renews its recommendation that our coaling stations at Honolulu, the Samoan Islands, and at Pichingue, in Lower California, shall be fixed by Congress on a firm basis, and that additional coaling and naval stations shall be established at some or all of the following points: "Samana Bay, or some port in Hayti; Curaçao, in the Caribbean Sea; Santa Catharina, in Brazil; the Straits of Magellan; La Union, in Salvador, or Amapala, in Honduras; Tullear Bay, in Madagascar; Monrovia, in Liberia; the island of Fernando Po; and Port Hamilton, in the Nau-how islands of Corea; from which latter naval station and the ports of Corea there should be established a regular line of steamers carrying the United States flag, connecting with the present American line between San Francisco and Japan. Similar stations should in addition be maintained, one at the best point on the Atlantic side of the Isthmus of Panama, and another at the islands of Flamenco, Perico, Culebra, and Ileñao, on the Pacific side, now owned by American corporations."

GENERAL RECOMMENDATIONS.

In the last two annual reports made by this Department, various recommendations and suggestions were made bearing upon the condition and employment of the naval personnel, which occasion is now taken to restate and reiterate. They concern, first, the reform of abuses which have crept into the service, and, secondly, the adoption of measures beneficial to the officers.

SOLICITATIONS IN BEHALF OF OFFICERS.

Prominent among existing abuses is the practice of endeavoring to bring about or modify departmental action in behalf of officers by the solicitations of those possessed of political or social influence. The detail of officers must be so arranged as to give regular and frequent sea service, not only for considerations of fairness, but for the welfare of the service as dependent upon the efficiency of the officers themselves. The nature of service at sea is such that practice must be constant in order to preserve efficiency. Five years of intermission not only have the effect of making an officer lose his grasp of his work, but create a positive disinclination for sea-duty that tends further to impair efficiency. Under this administration the effort has been made to limit and apportion shore service in such a way as to secure the best results. More must be done in the same direction before the detail of officers can approach a perfect system.

Some radical measures should be taken to render the solicitations of outside persons in favor of officers discreditable both to the patron and

to the officer for whom influence is exerted. It is an impertinence to the Department, proceeding on the assumption that its authorities will so far forget the force of their public duty as to administer a governmental establishment upon considerations of a private and personal nature, and that they will yield to the importunities of friends what a sense of public obligation would forbid. Possibly the result might be accomplished by a rule which should cause the publication of communications of this nature addressed to the Department. Whatever method may be adopted, the Department should endeavor, as far as lies in its power, to make such intervention in behalf of officers a public discredit to all concerned.

RESTORATION OF DISMISSED OFFICERS.

No more powerful influence for the demoralization of the naval service is to be found than that which results from the restoration of officers dismissed for drunkenness or other misconduct, or for demonstrated incapacity. Cases of restoration which have occurred in the past would hardly have been possible but for a lenient spirit in the service, which, although it may proceed from kindly motives, indicates an indifference on the part of officers themselves concerning the tone of the Navy, and a disregard of their imperative duty to contribute by every means in their power to the maintenance of a high standard of professional character. Public opinion should not only sternly condemn all officers who are guilty of such misconduct as to disqualify them from service on the active list of the Navy, but also those who, from whatever cause, lend themselves to efforts for the restoration of worthless and ejected members of their profession.

While affirming in the strongest terms its opinion of the general inexpediency of restoring dismissed officers, the Department also relies for the protection of the service upon the unconstitutionality of legislation for such purposes, as set forth in the message of July 2, 1884, returning without executive approval a bill contemplating such action, as follows:

"It is apparent that, should this bill become a law, it will create a new office, which can be filled by the appointment of the particular individual whom it specifies, and cannot be filled otherwise; or it may be said, with perhaps greater precision of statement, that it will create a new office upon condition that the particular person designated shall be chosen to fill it. Such an act, as it seems to me, is either unnecessary and ineffective or it involves an encroachment by the legislative branch of the Government upon the authority of the Executive. As the Congress has no power under the Constitution to nominate or appoint an officer, and cannot lawfully impose upon the President the duty of nominating or appointing to office any particular individual of its own selection, this bill, if it can fairly be construed as requiring the President to make the nomination and, by and with the advice and consent of the Senate, the appointment which it authorizes, is in manifest violation of the Constitution. If such be not its just interpretation, it must be re-

garded as a mere enactment of advice and counsel, which lacks, in the very nature of things, the force of positive law, and can serve no useful purpose upon the statute-books."

The foregoing clear exposition of the force of section 2 of Article II of the Constitution which provides that the President "shall nominate and by and with the advice and consent of the Senate shall appoint ambassadors, other public ministers and consuls, judges of the Supreme Court, and *all other officers of the United States*," shows that an effectual barrier has been established by the Constitution to any restoration to the Navy, by legislation, of particular officers who have been dismissed therefrom; and the Supreme Court has further established the proposition that such dismissals when once accomplished cannot be revoked by the Executive. No more important doctrines than these can be stated bearing upon the welfare of our Navy personnel.

BENEFICIAL MEASURES.—PROMOTION.

Among the beneficial measures to be adopted to relieve the personnel from existing burdens or hardships, the foremost in importance is one which shall secure the more rapid advancement of capable officers. There are under present laws 325 lieutenants of both grades. These are not young men. A large number if not all of them have reached an age when they are fit for command. Under existing arrangements they will not have commands for many years to come, and many of them will retire from active service in grades far short of the highest. This continuance until advanced age in a subordinate position destroys the power of initiative, fosters an instinctive avoidance of responsibility, and takes away all capacity for command when it comes.

In order to hasten promotion, the most vital step is to secure the removal from the active list of those who from age or other causes have gradually become unfitted for service at sea. The law has wisely fixed a term at which the active duty of all officers shall cease. This enactment proceeds on the assumption that the period of an officer's usefulness comes to an end at sixty-two years of age. There are doubtless a few rare and exceptional cases in which the Navy, by the adoption of this arbitrary rule, loses an officer still capable of valuable service. There are many more cases in which the term assigned by law as the end of a useful career is anticipated by the progress of mental or physical waste or deterioration. In such cases the continuance of the officer on the active list is a gross injustice to those in the lower grades, and an injury to the whole service. To the suggestion that some of these officers may have served during the war, and that it would be an act of ingratitude to retire them before the fixed age, to make room for younger men, it may be replied that though a pension roll may be a just provision for officers whose usefulness has passed away, the active list of the Navy should not be used for this purpose. That list should contain only the names of those who may safely be sent to sea

to perform duties falling to their respective grades; and unless the service recognizes this fact and acts upon it there is danger of sweeping legislation under which the good and the inefficient will alike suffer.

The responsibility for delay in effecting this needed reform rests partly with the Department and partly with the service itself. Up to a recent period the Department had taken no action looking to a remedy for the evil. In the annual report of last year, however, a measure was proposed which it was believed would accomplish the desired result, and at the same time cause the least possible disturbance of existing interests. The proposed plan contemplated the selection from the whole number of officers in each corps, by a board of officers of high rank, of a number of officers equal to that prescribed for that corps by the act of August 5, 1882, and the retention on a supernumerary list of the officers not selected, with leave-of-absence pay, and without promotion, subject only to active service in cases of special exigency. A bill was soon after introduced in the Senate covering the recommendation of the Department. Interrogatories were addressed to officers, calling for a full expression of opinion as to the steps necessary to be taken to bring about the result, but the replies, of which a large number were received, contained objections to every proposition, and submitted no definite plan as a substitute.

It is clear that the movement towards reform, if it is to have any vitality, must receive a stimulus and encouragement in the service itself. If the officers do not put forth an effort, nobody else will. It is to be presumed that they know best what are the needs of their own body, and it is for them to consider whether the service shall continue to be subject to reproach, and the advancement of capable men be retarded, through an excessive conservatism, which looks not at the good of the whole establishment, but at securing to individuals, the unworthy as well as the worthy, their emoluments and positions.

If it should be found that insuperable objections exist to the measure proposed last year, the Department presents an alternative, with an urgent recommendation that it shall be made at an early date the subject of Congressional examination and action. The details of the plan are as follows:

1. That the active list of line officers of the Navy, in addition to the present admiral and vice-admiral, whose pay and rank shall continue as heretofore, shall consist of six vice-admirals, having the pay now allowed by law to rear-admirals, and ranking with major-generals; ten rear-admirals, having the pay now allowed by law to commodores, and ranking with brigadier-generals; fifty captains; ninety commanders; one hundred and twenty-seven lieutenant-commanders; two hundred and ninety lieutenants; and one hundred and fifty ensigns: the junior grade of lieutenant being abolished, and the officers now in that grade being commissioned immediately as lieutenants, but with the pay now allowed to junior lieutenants, until their arrival, in the regular course

of advancement, to a position corresponding to the foot of the present list of lieutenants.

2. That all officers be retired immediately who are to attain the age of sixty-two years within two years from July 1, 1885, the commodores so retired to have the rank of rear-admiral; and that the officers remaining on the list be appointed in the order of their seniority, to the grades of vice-admiral and rear-admiral, subject to the usual examination.

3. That section 1445 of the Revised Statutes, excluding officers of the junior grades of the line and staff corps from retirement on account of age, be repealed.

4. That whenever a vacancy shall occur in the list of rear-admirals or in that of captains, a Board shall be convened, to be composed of not less than three officers of flag rank, who shall designate, in the case of each vacancy in the rear-admirals' list, two captains, and in the case of every fourth vacancy in the captains' list, one commander, to be retired; and that the captains and commanders so designated shall be placed on the retired list of their grade, under the same conditions as if they had been retired on account of age; and thereafter the senior captain or the senior commander, as the case may be, shall be promoted, subject to the usual examination, to fill the vacancy in the grade above.

As an additional safeguard, it should be further provided that no officer should be reduced in rank or deprived of his commission by anything contained in the proposed measure; nor should it affect in any way existing laws in regard to officers who may have received the thanks of Congress.

The essential features of the above plan are the retirement of two captains for every captain promoted, and one commander for every four commanders promoted; and the rearrangement of the numbers of officers in the different grades, retaining the aggregate fixed by the act of August 5, 1882. It is believed, as the result of careful calculation, that such a measure would bring about a continuous and regular flow of promotion, and at the same time relieve from active service those who, from advancing age or from other causes, are unequal to its heavy burdens and grave responsibilities, while giving them a comfortable competence.

The incidental provisions of the above plan, which might be adopted without reference to the main question, are the substitution of the grades of vice-admiral and rear-admiral for those of rear-admiral and commodore, respectively, in order that officers in command of the squadrons of the United States may be placed on a footing of equality with the officers in command of foreign squadrons, without in any way altering or disturbing their relative precedence with general officers of the Army; and the extension to junior officers who may have reached the limits of age, of the provisions of the retiring laws, now confined to officers above the grade of lieutenant-commander. In order to provide for the immediate adoption of the plan, it is further recommended that those officers who have but two years more to serve be retired at once.

The Department renews the special recomm... report of last year for the relief of lieutenants, ... neers, and mates; and it would also suggest th... made more nearly equal to that of officers of th... other corps.

ADDITIONAL EMPLOYMENT FOR NA...

If nothing can be done to prevent the present ... grades of the service, it is at least possible ... placed under such heavy disadvantages, employ... ities suited to their age and experience. In earl... ment has stated at length its views upon this ... signs to make a general reference to them at the...

REVENUE-MARINE NAVY.

It has been pointed out that at the time wh... wise to reduce the number of officers in the Navy... that number was greater than their occupation... in the employ of the Government a subsidiary ... corps of officers, under the fiscal department of ... ing duties at once military and nautical, indistin... sential requirements from those of the Navy prop... organization, known as the Revenue-Marine Serv... war for war service, while in time of peace it ... that it had its separate fleet of vessels, its ... naval school; and that the two navies covered ... operations that, in the words of the Treasury ... sion the management of the Revenue-Marine ... "difficult to conceive that discrimination could ... between services subjected to equally hazardous ... tant military duties, both in time of peace and ... was proposed to strengthen both organizations ... the subsidiary navy, by uniting them; securing ... the revenue service the tenure of their positions ... by every safeguard; bettering their condition by ... benefit of naval laws, which they had sought ... their own corps; and opening the service, as va... foot of the list, to the present junior officers of ... was conceived on the most favorable basis for the ... enue Marine officers, and it is a singular and ... though the officers of the Navy had nothing to ... and in formulating it only acted under the Depar... fears of the Revenue Marine Corps were so arou... tions and scandalous charges on the part of inte... they were led, with some exceptions, to regard a ...

mon interest of both services as a hostile attack, and rejected the very propositions which their free judgment would doubtless have eagerly welcomed.

In thus frankly alluding to the causes of opposition to the measure, it is not the purpose of the Navy Department to represent that it was actuated solely or chiefly by the advantages to be derived from the change by the officers of the Revenue Marine. Such considerations, although important, could not form the ground of action on the part of the Secretary of the Navy. The question was approached, as it properly should be approached, from the starting-point of naval reform; but in pursuing the main object every care was taken to avoid infringing upon vested rights or disturbing vested interests.

LIGHT-HOUSE NAVY.

A second subsidiary fleet is maintained in the public service, employment in which should also be open to naval officers. This is composed of the vessels of the Light-House Establishment, numbering twenty-three steamers, suitable in time of war for auxiliary use in the Navy. These vessels are now officered by seafaring men, with no naval organization or training, whose maintenance forms a large item in the cost of our light-house service. It is estimated that the sum of $100,000 per annum would be saved by employing naval lieutenants, ensigns, and engineers in these vessels, while the duty thus imposed upon them of accurately placing buoys and handling small steamers on the coast would be a direct professional benefit.

COAST-SURVEY NAVY.

A third fleet, that of the Coast and Geodetic Survey, is at the present time intrusted to naval officers. Their duties include not only the navigation of the vessels, but the execution of all the hydrographic and a part of the topographic surveys for coast-charts, as well as the prosecution of scientific investigations of the bed of the ocean. In performing these duties, they work under another department, being withdrawn for the time from the direction and control of their natural head, and placed on a subsidiary footing elsewhere. For this artificial arrangement there is not a shadow of reason, and it presents grave difficulties of a positive kind. In the first place, the withdrawal of the officers of the Navy from the direction of the Navy Department is in itself prejudicial to discipline, and a constant source of inconvenience. Secondly, there is a clear injustice, whatever efforts may be made to avoid it in practice, in requiring naval officers to perform naval duties under another chief, with whose office they can never be identified, and giving them work to do, the results of which will be formulated and published by other hands, whose real efforts are devoted to a work remote from maritime affairs. The Coast Survey, by its gradual development into an office for geodetic operations, has transferred its main sphere of employment to the interior of the country, and the observations necessary

for the coast charts have been turned over to the naval officers, detailed for duty under the Superintendent, who still retains the direction of their labors. At the same time the Navy Department is maintaining as a necessary part of its organization a Hydrographic Office, which performs exactly the same work upon foreign coasts which the Coast Survey, through the assistance of naval officers, performs upon our own. Every reason exists for a reorganization of these two offices in such a way that all the hydrographic surveying of the Government shall be performed under a single head, and that the direction of the naval officers who do the actual work shall proceed from the Hydrographic Office of the Navy Department.

It is believed that the above and all other branches of Government service, whose duties are essentially nautical, demanding the same acquirements and the same experience as are to be found among naval officers, should be thrown open to them, and that the direction of the services should be intrusted to the Navy Department, whereby greater unity of purpose and consistency of action would be secured. The Navy in time of war comprises the whole maritime force of the Government, and each partial nucleus of that force should be brought permanently under the general naval administration, instead of continuing as a foreign growth in a department organized for a totally different purpose.

It is with a deep conviction of its essential truth, only strengthened by added experience and observation, that the Department now takes occasion to repeat the fundamental doctrine upon which the above conclusions rest—a doctrine first enunciated two years ago, and renewed in the report of last year, "*that the officers and seamen of the Navy should be employed to perform all the work of the National Government upon or in direct connection with the ocean.*" Notwithstanding the opposition of those who, suspecting in the doctrine an impending danger to themselves, assailed with rancor the administration of the Department and the motives of naval officers, and endeavored by personal assault to divert attention from the main question, and to confuse the broad and indisputable principle with irrelevant issues, there are unmistakable signs of a growing sentiment in favor of the proposition, and of its application to the organization of the public service It is believed that the day is not far distant when that sentiment will make itself heard with no uncertain voice, and will demand recognition. That changes so considerable and so far-reaching should be accomplished at once is not to be expected; but the ultimate result, although delayed, is inevitable, and it is a source of satisfaction to the Department that the way to accomplish it has been clearly pointed out.

THE COMMERCIAL MARINE.

The close connection between the improvement of the Navy and the development of a flourishing mercantile marine has been often pointed

out, but has hitherto failed so to fasten itself upon public opinion as to lead to any direct governmental action. Without a prosperous carrying trade on the ocean in ships built in this country, it is impossible to reach a high degree of naval efficiency. The germ of a maritime force may exist, but it must remain undeveloped while there is no commercial fleet and no maritime population upon which to draw as a naval reserve. Can it be supposed that in the event of war fifty vessels of all sizes and 8,000 men will fight our naval battles, transport our troops, maintain blockades, and cut off the enemy's commerce? Yet almost within such narrow limits are we now confined by the deplorable condition of our commercial marine.

In order to make our merchant fleet commensurate with our trade, our coast-line, and the number and wealth of our commercial cities, it is necessary to have not only river steamboats and lake craft, not only a few stray sailing vessels and coasting steamers, but great lines of ocean steamships of high speed and large capacity, forming regular permanent communication with Europe, with South America, with Asia, with Australia, carrying our flag to the most distant lands, and saving to our people the vast profits, now grasped by other hands, in carrying our imports and exports across the sea.

Observation and experience show that there is one way and only one to accomplish this result, through direct encouragement given by the Government to those who are willing to undertake such enterprises. Whether in the form of bounties upon construction, or of payment for carrying the mails, or both, such aid must be tendered by the Government before American capitalists can be induced to embark in the business. Each method has its special advocates, and each has been successfully tried abroad. Until one or the other is adopted by the United States, our maritime development will be arrested, and our Navy will suffer and decline.

A recent enactment has repealed the laws requiring all American vessels arbitrarily to carry the foreign mails. This salutary measure should now be supplemented by a provision that contracts for carrying such mails in American lines of steamers over all the principal ocean highways should be let for terms of years to the lowest bidder, adequate compensation therefor to be paid by the Government upon the same principle as that adopted in establishing our great national post-routes on the land.

Not until by such peaceful methods we restore our commercial power and cover not only our own territory, but the ocean, with the proofs of our resources, our enterprise, and our skill, shall we become, in fact as well as in name, the equal of the other great nations of the world.

WILLIAM E. CHANDLER.
Secretary of the Navy.

APPENDIX.

No. 1.—ESTIMATES, SECRETARY'S OFFICE, ETC.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, *by the Navy Department.*

Detailed object of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year, ending June 30, 1885.
SALARIES, OFFICE OF THE SECRETARY OF THE NAVY.		
Secretary, July 7, 1884	$8,000	
Chief clerk (same act)	2,500	
Disbursing clerk (same act)	2,250	
Five clerks of class four (same act)	9,000	
One clerk of class four, in charge of files and records (submitted)	1,800	
Three clerks of class three, July 7, 1884	4,800	
One stenographer (same act)	1,600	
One stenographer (same act)	1,400	
Two clerks of class two (same act)	2,800	
Six clerks of class one (same act)	7,200	
Submitted, that one of the clerks of class one may be made a clerk of class two (submitted)	200	
Four clerks, at $1,000 each, July 7, 1884	4,000	
One telegraph operator (same act)	1,000	
One carpenter (same act)	1,000	
Two messengers (same act)	1,680	
Three assistant messengers (same act)	2,160	
One messenger boy (same act)	420	
One messenger boy (same act)	240	
Three laborers (same act)	1,980	
One clerk of class two (for Inspection Board, same act)	1,400	
One laborer (for Inspection Board, same act)	660	
One clerk of class two (for Examining and Retiring Board, same act,)	1,400	
One laborer (for Examining and Retiring Board, submitted)	660	
One clerk of class one (in care of library, July 7, 1884)	1,200	
One assistant messenger (in care of library, same act)	720	
	60,070	$57,410
CONTINGENT EXPENSES, NAVY DEPARTMENT.		
For stationery, furniture, newspapers, plans, drawings, drawing materials, freight, expressage, postage, and other absolutely necessary expenses of the Navy Department and its various bureaus and offices, July 7, 1884	13,500	
	13,500	11,000
PRINTING AND BINDING.		
Printing and binding for the Navy Department, to be executed under the direction of the Public Printer	75,000	63,000

Estimates of appropriations required for the service of the fiscal year, &c.—**Continued.**

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1885.
CONTINGENT EXPENSES.		
For rent and furniture of buildings and offices not in navy-yards; expenses of courts-martial and courts of inquiry, boards of investigation, examining boards, with clerks and witnesses' fees, and traveling expenses and costs; stationery and recording; expenses of purchasing paymasters' offices at the various cities, including clerks, furniture, fuel, stationery, and incidental expenses; newspapers and advertising; foreign postage; telegraphing, foreign and domestic; telephones; copying; care of library; mail and express wagons, and livery and express fees; costs of suits; commissions, warrants, diplomas, and discharges; relief of vessels in distress, and pilotage; recovery of valuables from shipwrecks; quarantine expenses; care and transportation of the dead; reports, professional investigation; cost of special instruction, and information from abroad, and the collection and classification thereof; and all other emergencies and extraordinary expenses, arising at home or abroad, but impossible to be anticipated or classified, exclusive of personal services in the Navy Department or any of its subordinate bureaus or offices at Washington, District of Columbia	$100,000 00	$100,000
PAY, MISCELLANEOUS.		
For two secretaries, one to the Admiral and one to the Vice-Admiral; clerks to paymasters, clerks at inspections, navy-yards and stations, and extra pay to men enlisted under honorable discharge; commission and interest, transportation of funds, exchange, mileage to officers while traveling under the orders of the United States, and for actual personal expenses of officers while traveling abroad under orders, and for traveling expenses of apothecaries, yeomen, and civilian employés; and for actual and necessary traveling expenses of naval cadets while proceeding from their homes to the Naval Academy for examination and appointment as cadets, and for payment of any such officers as may be in service, either upon the active or retired list, during the year ending June thirtieth, eighteen hundred and eighty-six, in excess of the numbers of each class provided for in this act, and for any increase of pay arising from different duty, as the needs of the service may require	350,000 00	350,000

Statement of the appropriations for the fiscal year ending June 30, 1884, for the Department of the Navy, showing the amount appropriated under each specific head of appropriation, the amount expended under each head, and the balance remaining unexpended on the 30th of June, 1884.

	Balance on hand June 30, 1883.	Appropriations for fiscal year ending June 30, 1884.	Transferred to appropriations by appropriation warrant.	Transferred from appropriations by appropriation warrant.	Amounts applicable to the service for the fiscal year ending June 30, 1884.	Amount expended fiscal year ending June 30, 1884.	Balances June 30, 1884.
Pay of the Navy	$2,051,072 59	$7,133,980 00			$9,185,052 59	$7,002,501 84	$2,182,550 75
Pay, miscellaneous		300,000 00				279,983 83	20,016 17
Contingent, Navy		100,000 00				97,830 02	2,169 98
Pay of the Marine Corps	215,668 23	642,985 00			858,653 23	633,712 63	224,940 60
Contingent, Marine Corps		25,000 00				24,999 68	32
Provisions, Marine Corps		60,000 00				59,983 59	16 41
Clothing, Marine Corps		77,000 00				76,536 63	463 37
Fuel, Marine Corps		18,000 00				17,976 41	23 59
Military stores, Marine Corps		9,786 50				9,422 68	363 82
Transportation and recruiting, Marine Corps		10,000 00				10,000 00	
Repairs of barracks, Marine Corps		10,000 00				10,000 00	
Forage for horses, Marine Corps		5,400 00				3,550 00	1,850 00
Pay, professors and others, Naval Academy		53,559 00				52,581 75	977 25
Pay, watchmen and others, Naval Academy		23,062 50				23,062 50	
Pay, mechanics and others, Naval Academy		14,590 23				14,590 23	
Pay, steam employés, Naval Academy		7,671 00				7,671 00	
Repairs, Naval Academy		21,000 00				21,000 00	
Heating and lighting, Naval Academy		17,000 00				17,000 00	
Library, Naval Academy		2,000 00				2,000 00	
Stationery, Naval Academy		2,000 00				2,000 00	
Board of Visitors, Naval Academy		1,500 00				1,500 00	
Chemistry, Naval Academy		2,500 00				2,500 00	
Miscellaneous, Naval Academy		34,600 00				34,600 00	
Stores, Naval Academy		800 00				800 00	
Materials, Naval Academy		1,000 00				1,000 00	
Navigation and navigation supplies		100,000 00				83,088 81	16,911 19
Ocean surveys, Navigation		10,000 00				7,106 91	2,893 09
Contingent, Navigation		4,000 00				3,853 42	146 58
Civil establishment, Navigation		5,000 00				4,955 97	44 03
Ordnance and ordnance stores		150,000 00				143,090 12	6,909 88
Steel rifled breech-loading guns		83,939 10		$674 10	83,265 00	30,683 40	52,581 60
Repairs, Ordnance		15,000 00				13,565 34	1,434 66
Contingent, Ordnance		3,000 00				2,999 40	60
Civil establishment, Ordnance		5,000 00				4,995 00	5 00
Torpedo corps		50,000 00				45,689 49	4,310 51
Torpedoes		100,000 00					100,000 00
Equipment of vessels		800,000 00				792,844 41	7,155 59
Transportation and recruiting, Equipment and Recruiting		40,000 00				34,317 32	5,682 68
Contingent, Equipment and Recruiting		15,000 00				14,869 45	130 55

Statement of the appropriations for the fiscal year ending June 30, 1884, for the Department of the Navy, &c.—Continued.

	Balance on hand June 30, 1883.	Appropriations for fiscal year ending June 30, 1884.	Transferred to appropriations by appropriation warrant.	Transferred from appropriations by appropriation warrant.	Amounts applicable to the service for the fiscal year ending June 30, 1884.	Amount expended fiscal year ending June 30, 1884.	Balances June 30, 1884.
tablishment, Equipment and Recruiting		$9,000 00				$8,883 44	$116 56
nance, Yards and Docks		200,000 00				195,896 05	4,103 95
gent, Yards and Docks		20,000 00				11,237 23	8,762 77
tablishment, Yards and Docks		24,000 00				23,998 78	1 22
navy-yards and stations			$50,000 00		$50,000 00	49,899 39	100 61
ard, Brooklyn, N. Y		100,000 00				52,638 00	47,362 00
ard, Washington, D. C		15,000 00				9,584 00	5,416 00
ard, Mare Island, California		275,000 00				214,926 14	60,073 86
s and preservation at navy-yards		200,000 00		$50,000 00	150,000 00	142,843 82	7,156 18
Asylum, Philadelphia, Pa		59,813 00				46,954 92	12,858 08
training station, Coasters' Harbor Island, Rhode Island		45,000 00				38,749 44	6,250 56
Medical department, Medicine and Surgery		40,000 00				24,863 81	15,136 19
Naval hospital fund		30,000 00				29,984 72	15 28
Contingent, Medicine and Surgery		25,000 00				14,409 31	10,590 69
Repairs, Medicine and Surgery		15,000 00				14,446 48	553 52
Civil establishment, Medicine and Surgery		20,000 00				19,807 60	192 40
Provisions, Navy		1,100,000 00				1,000,086 41	99,913 59
Contingent, Provisions and Clothing		40,000 00				30,439 38	9,560 62
Civil establishment, Provisions and Clothing		6,000 00				6,000 00	
Construction and Repair		1,334,000 00				1,285,973 31	68,026 69
Civil establishment, Construction and Repair		20,000 00				17,023 85	2,976 15
Steam machinery		1,000,000 00				949,786 04	50,213 96
Contingent, Steam Engineering		1,000 00				505 75	494 25
Civil establishment, Steam Engineering		10,000 00				9,032 00	968 00
Add this amount, difference in general account of advances (which is not an expenditure), being, June 30, 1884, $1,407,272.87; and on June 30, 1883, $818,668.31, difference						588,604 56	
Deduct.		14,543,186 33				14,375,436 26	3,022,421 35
This sum to Naval Asylum, as that is included in appropriations, but was brought to the credit of asylum by requisition February 28, 1884, and is included in expenditures chargeable to Navy appropriations as refunded and deducted from amount drawn that month						*59,813 00	
						14,315,623 26	

Estimate of the amount required to pay the officers of the United States Navy for the fiscal year ending June 30, 1886.

Grade.	Sea duty.			Other duty.			Waiting orders.		
	No.	Pay per annum.	Total.	No.	Pay per annum.	Total.	No.	Pay per annum.	Total.
Admiral				1	$13,0 0	$13,000			
Vice-Admiral				1	8,000	8,000			
Rear-admiral, chief of Bureau				1	5,000	5,000			
Rear-admirals	2	$6,000	$12,000	3	5,000	15,000	1	$4,000	$4,000
Commodores, temporary rank rear-admiral	3	5,000	15,000						
Commodores				12	4,000	48,000	4	3,000	12,000
Captains, chiefs of Bureau				2	5,000	10,000			
Captains	10	4,500	45,000	24	3,500	84,000	9	2,800	25,200
Commander, chief of Bureau				1	5,000	5,000			
Commanders	26	3,500	91,000	43	3,000	129,000	15	2,300	34,500
Lieutenant-commanders, second 4 years	19	3,000	57,000	26	2,600	67,600	11	2,200	24,200
Lieutenant-commanders, first 4 years	11	2,800	30,800	6	2,400	14,400	1	2,000	2,000
Lieutenants, second 5 years	92	2,600	239,200	81	2,200	178,200	27	1,800	48,600
Lieutenants, first 5 years	25	2,400	60,000	23	2,000	46,000	12	1,600	19,200
Lieutenants, junior grade, second 5 years	15	2,000	30,000	11	1,700	18,700	7	1,400	9,800
Lieutenants, junior grade, first 5 years	30	1,800	54,000	19	1,500	28,500	7	1,200	8,400
Ensigns, second 5 years	18	1,400	25,200	16	1,200	19,200	4	1,000	4,000
Ensigns, first 5 years	84	1,200	100,800	51	1,000	51,000	18	800	14,400
Naval cadets, undergraduates	82	950	77,900	1	500	500	14	500	7,000
Medical director, chief of Bureau				1	5,000	5,000			
Medical director, after 20 years date of commission as surgeon				12	4,000	48,000	2	3,000	6,000
Medical inspectors, fleet surgeons	3	4,400	13,200						
Medical inspectors, after 20 years date of commission as surgeon	1	4,400	4,400	6	4,000	24,000	2	3,000	6,000
Medical inspectors, after 15 years date of commission as surgeon	1	3,700	3,700	1	3,600	3,600	1	2,800	2,800
Surgeons, after 15 years date of commission	5	3,700	18,500	5	3,600	18,000	2	2,800	5,600
Surgeons, after 10 years date of commission	6	3,500	21,000	6	3,200	19,200	1	2,600	2,600
Surgeons, after 5 years date of commission	6	3,200	19,200	6	2,800	16,800			
Surgeons	4	2,800	11,200	5	2,400	12,000	1	2,000	2,000
Passed assistant surgeons, after 5 years date of commission	30	2,200	66,000	33	2,000	66,000	7	1,700	11,900
Passed assistant surgeons	2	2,000	4,000	2	1,800	3,600			
Assistant surgeons	3	1,700	5,100	5	1,400	7,000			
Assistant surgeons, not in line of promotion				1	1,800	1,800			
				1	1,600	1,600			
Pay directors, after 20 years date of commission as paymasters				9	4,000	36,000	4	3,000	12,000
Pay inspector, chief of Bureau				1	5,000	5,000			
Pay inspectors, after 20 years date of commission as paymasters	1	4,400	4,400	8	4,000	32,000	1	3,000	3,000
Pay inspectors, fleet paymasters	2	4,400	8,800						
Paymaster, fleet paymaster	1	4,400	4,400						
Paymasters, after 15 years date of commission	8	3,700	29,600	9	3,600	32,400	4	2,800	11,200
Paymasters, after 10 years date of commission	1	3,500	3,500	5	3,200	16,000	1	2,600	2,600
Paymasters, after 5 years date of commission	5	3,200	16,000	8	2,800	22,400			
Paymasters	1	2,800	2,800	5	2,400	12,000			
Passed assistant paymaster, after 5 years date of commission	9	2,200	19,800	6	2,000	12,000	2	1,700	3,400

Estimate of the amount required to pay the officers of the United States Navy for the fiscal year ending June 30, 1886—Continued.

Grade.	Sea duty.			Other duty.			Waiting orders.		
	No.	Pay per annum.	Total.	No.	Pay per annum.	Total.	No.	Pay per annum.	Total.
Passed assistant paymaster	2	$2,000	$4,000	5	$1,800	$9,000	4	$1,500	$6,000
Assistant paymasters, after 5 years date of commission	4	1,900	7,600	3	1,600	4,800	1	1,200	1,200
Assistant paymasters	5	1,700	8,500	4	1,400	5,600	2	1,000	2,000
Chief engineer, chief of Bureau				1	5,000	5,000			
Chief engineers, fleet engineers	2	4,400	8,800						
Chief engineers, after 20 years date of commission	3	4,400	13,200	21	4,000	84,000	3	3,000	9,000
Chief engineers, after 15 years date of commission	2	3,700	7,400	1	3,600	3,600	1	2,800	2,800
Chief engineers, after 10 years date of commission	10	3,500	35,000	2	3,200	6,400	1	2,600	2,600
Chief engineers, after 5 years date of commission	1	3,200	3,200	6	2,800	16,800	3	2,400	7,200
Chief engineers	8	2,800	22,400	3	2,400	7,200	2	2,000	4,000
Passed assistant engineers, after 5 years date of commission	34	2,200	74,800	30	2,000	60,000	14	1,700	23,800
Passed assistant engineers	4	2,000	8,000	5	1,800	9,000	1	1,500	1,500
Assistant engineers, after 5 years date of commission	17	1,900	32,300	14	1,600	22,400	6	1,200	7,200
Assistant engineers	23	1,700	39,100	14	1,400	19,600	7	1,000	7,000
Chaplains, after 5 years date of commission	5	2,800	14,000	8	2,300	18,400	7	1,900	13,300
Chaplains	3	2,500	7,500	1	2,000	2,000			
Professors mathematics, after 15 years date of appointment				4	3,500	14,000			
Professors mathematics, after 10 years date of appointment				2	3,000	6,000			
Professors mathematics, after 5 years date of appointment				3	2,700	8,100			
Professors mathematics				3	2,400	7,200			
Naval constructors, chief of Bureau				1	5,000	5,000			
Naval constructors, after 20 years date of appointment				1	4,200	4,200			
Naval constructors, after 15 years date of appointment				4	4,000	16,000			
Naval constructors, after 10 years date of appointment				4	3,700	14,800			
Assistant naval constructors, after 8 years date of appointment				4	2,600	10,400			
Assistant naval constructors, after 4 years date of appointment				3	2,200	6,600			
Assistant naval constructors				3	2,000	6,000			
Civil engineers, after 10 years date of appointment				3	3,000	9,000			
Civil engineers, after 5 years date of appointment				3	2,700	8,100			
Civil engineers				4	2,400	9,600			
Secretaries to the Admiral and Vice-Admiral				2	2,500	5,000			
Boatswains, after 12 years date of appointment	9	1,800	16,200	12	1,600	19,200	8	1,200	9,600
Boatswains, after 9 years date of appointment	2	1,600	3,200				1	1,000	1,000
Boatswains, after 6 years date of appointment				5	1,300	6,500	2	900	1,800
Boatswains, after 3 years date of appointment	5	1,300	6,500	1	1,000	1,000			
Gunners, after 12 years date of appointment	8	1,800	14,400	22	1,600	35,200	5	1,200	6,000
Gunners, after 9 years date of appointment	1	1,600	1,600	1	1,300	1,300			
Gunners, after 6 years date of appointment				1	1,300	1,300			
Gunners, after 3 years date of appointment	1	1,300	1,300						
Carpenters, after 12 years date of appointment	7	1,800	12,600	14	1,600	22,400	11	1,200	13,200
Carpenters, after 9 years date of appointment	4	1,600	6,400				1	1,000	1,000
Carpenters, after 6 years date of appointment	1	1,400	1,400	5	1,300	6,500	2	900	1,800

Carpenters, after 3 years date of appointment	5	1,300	6,500	1	1,000	1,000			
Sailmakers, after 12 years date of appointment	4	1,800	7,200	10	1,600	16,000	4	1,200	4,800
Sailmakers, after 9 years date of appointment	3	1,600	4,800	2	1,300	2,600	5	1,000	5,000
Sailmakers, after 6 years date of appointment				2	1,300	2,600			
Sailmakers, after 3 years date of appointment							1	800	800
Mates	9	900	8,100	25	700	17,500	3	500	1,500
Naval cadets, under instruction (at Naval Academy)				199	500	99,500			

Estimate of the amount required to pay the retired officers of the United States Navy for the fiscal year ending June 30, 1886.

Grade.	Number.	Pay per annum.	Total.
Rear-admirals	43	$4,500	$193,500
Do	3	3,750	11,250
Do	2	3,375	6,750
Commodores	10	3,750	37,500
Do	3	3,375	10,125
Do	2	2,625	5,250
Captains	4	3,375	13,500
Do	3	2,675	7,875
Do	1	2,250	2,250
Do	2	1,950	3,900
Do	1	1,150	1,150
Do	1	900	900
Commanders	5	2,625	13,125
Do	1	2,250	2,250
Do	1	1,750	1,750
Do	1	1,400	1,400
Do	2	900	1,800
Lieutenant-commanders	12	2,250	27,000
Do	2	2,100	4,200
Do	1	1,950	1,950
Do	2	1,500	3,000
Do	2	1,100	2,200
Do	1	1,000	1,000
Do	1	700	700
Lieutenants	17	1,950	33,150
Do	2	1,200	2,400
Do	1	900	900
Lieutenants (junior grade)	11	1,500	16,500
Do	1	1,350	1,350
Do	3	900	2,700
Ensigns	4	1,050	4,200
Do	2	600	1,200
Do	1	500	500
Do	1	300	300
Medical directors	2	3,750	7,500
Do	14	3,300	46,200
Do	4	3,150	12,600
Do	1	2,400	2,400
Medical inspectors	2	3,300	6,600
Do	1	1,300	1,300
Surgeons	6	2,100	12,600
Do	1	1,650	1,650
Passed assistant surgeons	5	1,650	8,250
Do	1	1,100	1,100
Assistant surgeons	4	1,425	5,700
Do	1	950	950
Do	1	850	850
Pay directors	3	3,750	11,250
Do	7	3,300	23,100
Pay inspector	1	3,300	3,300
Do	1	2,200	2,200
Paymaster	1	2,625	2,625
Do	1	2,400	2,400
Do	1	2,100	2,100
Do	1	1,400	1,400
Passed assistant paymaster	1	1,650	1,650
Do	1	1,500	1,500
Assistant paymaster	1	1,425	1,425
Chief engineers	1	3,750	3,750
Do	5	3,300	16,500
Do	7	2,625	18,375
Do	1	1,200	1,200
Passed assistant engineers	15	1,650	24,750
Do	5	1,575	7,875
Do	2	1,100	2,200
Do	1	850	850
Do	1	480	480
Assistant engineers	13	1,425	18,525
Do	7	1,275	8,925
Do	2	950	1,900
Do	1	850	850
Do	1	600	600
Do	1	500	500
Chaplains	8	2,100	16,800
Professors of mathematics	3	2,625	7,875
Do	2	2,025	4,050
Do	1	1,800	1,800
Naval constructor	1	3,750	3,750

Estimate of the amount required to pay the retired officers, &c.—Continued.

Grade.	Number.	Pay per annum.	Total.
Civil engineers	2	$2,625	$5,250
Do	1	2,250	2,250
Boatswains	14	1,350	18,900
Do	1	1,050	1,050
Do	1	900	900
Do	1	600	600
Gunners	16	1,350	21,600
Carpenters	10	1,350	13,500
Sailmakers	10	1,350	13,500
Do	1	600	600
Petty officers, seamen, ordinary seamen, &c			2,400,000
Seven hundred and fifty boys			100,000

RECAPITULATION.

607 officers on sea duty	$1,391,600
719 officers on other duty	1,671,900
239 officers on waiting orders	409,500
1,565	3,473,000
346 officers on retired list	797,880
97 naval cadets not at Academy	85,400
199 naval cadets at Academy	99,500
Petty officers, &c	2,500,000
Total amount required	6,955,780

No. 2.—REPORT OF THE ADMIRAL OF THE NAVY.

WASHINGTON, D. C., *November* 12, 1884.

SIR: There is a general impression throughout the country that a very large amount of money (over four hundred millions of dollars) has been spent on the Navy since the war, without anything to show for it. This impression has hindered the advance of the Navy; for, whenever an attempt has been made to provide appropriations for this branch of the service, misinformed persons have taken the opportunity to bring forward this stupendous amount to show that the Navy Department has been reckless in its expenditures. This idea has been taken up by repeaters and echoed far and wide over the country, so that now millions of people are convinced that the Navy Department has wasted this immense sum of money.

It must be remembered that after the war, and up to 1869, a large sum of money was drawn from the Treasury to pay war debts, as well as to provide for the maintenance of the Navy It was not until 1869 that the Navy settled down to run on a reasonable annual appropriation for its maintenance. Up to that time bills were continually coming in for the construction of large iron-clads and heavy ships of war, of great speed, which had been built with the idea that we should be prepared for a meeting with foreign foes (we having been seriously in danger of it several times during the civil war). All the contractors for these vessels were not paid until the year 1869–'70, and it was not until after this date that the Navy was carried on with the ordinary appropriations.

The Navy can not be said to have been conducted on the footing of a peace establishment prior to 1869. This will appear by a reference to the appropriations from 1865 to 1869. During this time, bills to the amount of $190,000,000 in round numbers had to be paid for work contracted for during the height of the war, when the Union was struggling for its existence against intestine foes and preparing to resist those foreigners who seemed disposed to meddle in our affairs. I see on looking over the accounts that $80,000,000 was refunded into the Treasury, most of which was deposited after the year 1869, although appropriated previously.

Taking all things into consideration, including the fact that the war debt was not settled until this time, it seems to me that 1869 is the year with which criticisms should commence, if there has been anything in naval expenditure deserving criticism.

When it is considered that all the naval appropriations since 1869 were simply for the maintenance of the Navy (with the exception of $5,000,000 for new cruisers), the amount expended will be found to be nothing more than reasonable. What ships we had at the end of the war were mostly wooden vessels, which every year required more repairs as their lives were coming to an end. Those of them which still exist may be placed in the same catalogue with decrepit old men tottering toward their graves.

Since 1869 the average annual expenditure has been about $17,000,000, shown as follows:

Amount appropriated	$258,704,067
For increase of the Navy	4,907,454
For maintenance of the Navy	253,796,613

This sum divided by 15 gives about $17,000,000 a year.

In this connection it must be explained to the uninitiated that the money for maintenance of the Navy is not for the building of new vessels, but for the pay of officers and men, and for repairs, supplies, &c.

Compare our expenditure with that of any other navy of importance, and it will be proved that we have kept within reasonable bounds; and yet half the people in the country are convinced that naval appropriations are recklessly expended; they being content to take the word of any one who makes a statement for the purpose of keeping back the Navy.

The following is a statement of the expenditures for our Navy since 1869:

1869	$20,081,285 00	1879	$13,343,317 79
1870	18,985,165 11	1880	12,916,639 45
1871	19,265,240 52	1881	14,450,789 86
1872	17,694,685 76	1882	13,936,294 96
1873	19,552,272 16	1883	13,918,833 78
1874 (including new cruisers)	26,254,155 82		258,704,067 82
1875	18,825,526 97	For new ships	4,907,454 00
1876	17,937,354 72		
1877	14,074,113 27	Total for maintenance of the Navy	253,796,613 82
1878	17,468,392 65		

To the above amounts, which are the expenditures taken from the annual reports of the Secretaries of the Navy, there should be added the unpaid bills outstanding at the end of each year.

These bills do not appear in the reports of the Secretaries of the Navy from year to year, and although they amount to a large sum in the aggregate, they will not swell the expenditures to within seventy millions of the amount which it was asserted had been spent on the Navy since 1869.

List of vessels built since 1869, with cost of each.

Trenton	$1,319,715
Adams	450,909
Essex	477,411
Enterprise	489,152
Alliance	572,452
Alert	326,016
Huron	323,954
Ranger	347,845
Intrepid	295,845
Alarm	304,155
	4,907,454

The accompanying tabulated form (marked A) will show the expenditures in foreign navies and our own, both for maintenance and the construction of new ships. This exhibit will prove much in favor of our naval establishment, and will go far to put a stop to the cry that wasteful extravagance has been shown in the administration of its financial affairs. It will also show the necessity of our doing something towards building a navy, if we wish to keep pace with the spirit of the age and hold ourselves ready to maintain the respect of foreign nations. No argument is needed to prove the necessity of a navy for this country. Any one who is supposed to be a statesman must be very obtuse if he

ignores that necessity. The assertion that we want "a small but effective navy" does not cover our case. No *small* navy can be an efficient one, if we consider the needs of our country. It must be large enough to command the respect of the greatest naval power. It need not be as large as the naval forces of European states, but could be made efficient and useful by our taking care to adopt no designs in ships or guns that are not superior to those of any navy afloat. Up to 1850, or thereabouts, our policy was to build better vessels than were built in any part of the world, and thus for some years we maintained a small but very effective navy.

All the powers of Europe have been engaged for the last twenty years in increasing their navies, while we have been indifferently looking on, not even taking the trouble to profit by their successes or failures in modern ship-building.

It cannot be denied that the European naval powers have during this time built some grand ships, the large majority of which are still very efficient vessels of war. A few of the largest of them have, however, been shown to be unequal to modern requirements, and their types are considered as out of date.

Within the last three years ships of war have been produced by the workshops of England which in my opinion take the lead both for cruising and fighting, and seem to me to furnish good models for our imitation.

I will only mention the Esmeralda, a ship of 3,000 tons, built in England for the Chilian navy. She is the most perfect ship of her class ever built (excepting her want of sail-power), and deserves to be carefully considered when making plans for new ships in our Navy. As far as I can judge, I think she will prove to be a more formidable vessel than either the Boston or Atlanta, and from the reports of her speed (18.28 knots over a measured distance of 11 knots, with all her coal and stores on board) she shows herself to be unsurpassed as a cruising commerce destroyer.

There is no reason why we cannot build a ship of 5,000 tons, on the lines and plans of the Esmeralda, that will give a speed of 19 knots an hour, which would quite equal the speed of any merchant ship afloat.

While we are building cruisers we must not forget our defenseless coasts—defenseless in ships, guns, and forts. In my last report I submitted plans of a class of gunboats which would prove very serviceable on our coasts. We have still to construct the proper vessel to ensure certain destruction to those who desire to enter our ports against our wishes.

The plans that I lay before you are for a vessel of about 950 tons displacement—210 feet between perpendiculars, 28 feet beam, and 11 feet draught of water. She will have 3,500 horse-power—two propellers and a revolving rudder, which will enable her to steer as well going astern as going ahead. She will carry 152 tons of coal, and will steam for fourteen days at the rate of 10 knots. Her full speed will be not less than 17 knots per hour. She will carry seven tons of stores, or six weeks' provisions—officers and crew, all told, sixty-five. Vertical armor on bows of 3-inch steel—curved shield decks fore and aft of 2½-inch steel—extending three feet below the water-line. She will have steam-pumps that will discharge five tons of water per minute, besides auxiliary pumps. Her battery will consist of one 10-inch breech-loading rifled gun to fire from a casemate protected by 3-inch steel armor, so arranged as to fire ahead, on broadside, or well on the quarter; two breech-loading 6-inch rifled guns aft, that will have all-round fire, and six Hotchkiss revolving cannon of 2½ inches diameter. This is a heavier battery than is carried by any other vessel of this class.

The above is simply an outline of this proposed gunboat. When she is completed she will be a match for anything in our Navy, and will have speed enough to escape from a superior foe. When I first made an estimate for this vessel (unarmored and with engines of only 1,200 horse-power), I thought that the hull and engines might be built for about $250,000, but the hull and engines as now proposed will cost at least $350,000. I do not know what the battery will cost. That will be an extra matter.

I request that the above amount be asked for to insure a perfect vessel. It is not a large sum for so formidable a gunboat, ram, and torpedo vessel, in all of which qualities she will excel. To build this gunboat will take about the same time as was taken up in building the Dolphin. When finished she will be invulnerable against the ordinary rifled gun, when she is fighting bow on. She will run astern quite as fast as any ordinary cruiser will go ahead. This is the cheapest plan on which a powerful vessel can be built, and, in my mind, it is an important step to take towards the immediate and temporary protection of our defenseless coast.

Comparatively little has been done in this country towards building torpedo-boats. We have only one, the Alarm, and she is uncompleted. Although this vessel will make a very formidable gunboat when she is protected by steel armor (according to my original design), she is not fast enough to answer efficiently as a torpedo-boat. She should have a new engine which would insure her a speed of 14 knots. I recommend that she be completed and placed in condition for offensive warfare.

All other nations but our own are paying great attention to the building of torpedo-boats. France, Russia, and England have about a hundred each as coast defenders; and now England, in view of what is considered the insufficient number of her ships of war, proposes to make a special appropriation of $60,000,000 for her navy, and also to build 250 more torpedo vessels for cruising and home defense. She will probably complete the whole number of them while we are considering the project of building three or four. Our case seems to be a desperate one, and we should extricate ourselves from this deplorable condition as soon as possible. It is well enough for some persons to say that we do not need a large Navy, but, in my opinion, if war should break out, these very people would be the first to cry out against the Government for not providing adequate defenses.

I submit what I think the Government ought to do in the next two years:

(1) Complete the unfinished monitors and arm them with heavy rifled guns, making them rams as far as their models will admit.

(2) Appropriate money for all the vessels that were proposed to Congress last winter.

(3) Build as a commencement four of the heaviest monitors of great endurance and speed, each to carry four 16-inch rifles in turrets.

(4) Build twenty torpedo-boats of not less than 100 tons each, with a speed of 20 knots.

(5) One cruising iron-clad of not less than 4,000 tons.

(6) Have all our ships of over 1,250 tons supplied with torpedo-boats, fitted with noiseless condensing engines, so that they cannot be heard when approaching an enemy. (The ships' launches which are now called torpedo-boats in our Navy are perfectly useless for this purpose.)

This would be a beginning in the right direction, and if continued for a few years we might hope once more to have a respectable Navy.

I beg leave to send you a report of what has been done by the Board of Inspection, and also to suggest that the recommendations of the board

with regard to the monitors, now in the James River, be considered. They are evidently useless in their present condition, and are becoming more so every day. They do not form an important part of our naval force, but might in time of war be turned to fair account as harbor defenders in conjunction with forts.

I have the honor to be, very respectfully, your obedient servant,

DAVID D. PORTER,
Admiral United States Navy.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy.

A.

Tabulated form showing the expenditures of foreign nations for the maintenance of their navies during the last fifteen years, as well as the amounts expended for the construction of new ships since 1865; also a statement of the expenditures by the United States for the same purposes during the same periods of time.

Countries.	Approximate expenditures for the maintenance of the Navy, 1869-'84.	Expenditures for the construction of new vessels, 1865-'84.
England	$805,946,430 00	$91,000,000
France	630,000,000 00	121,000,000
Russia	345,000,000 00	83,583,180
Italy	142,500,000 00	38,000,000
Sweden	....	14,804,689
Germany	144,000,000 00	26,978,7[illegible]1
United States	253,796,613 82	4,907,454

NAVY DEPARTMENT,
BOARD OF INSPECTION AND SURVEY,
Washington, November 7, 1884.

SIR: I have the honor to submit the following report of inspections since November 19, 1883:

Vessels in commission inspected for general efficiency.

Name.	Date of inspection.	Remarks.
Shenandoah	November 20, 21, and 22, 1883.	
Michigan	December 4, 1883	
Swatara	December 11, 1883	
Franklin	December 13, 1883	
Marion	December 14, 1883	
Mahopac	January 3, 1884	
Canonicus	January 3, 1884	
Lehigh	January 3, 1884	
Manhattan	January 3, 1884	
Catskill	January 3, 1884	
Ajax	January 3, 1884	
Galena	February 22, 1884	
Ossipee	March 20 and 21, 1884	
Pensacola	May 15, 1884	
Alliance	June 20, 1884	By line officers of board
Richmond	August 28, 1884	End of cruise.
Brooklyn	October 15, 1884	Do.
RECEIVING SHIPS.		
Wabash	July 1, 1884	
Vermont	July 2, 1884	
Saint Louis	July 3, 1884	
Wyandotte	July 7, 1884	
Franklin	July 8, 1884	

Vessels examined under section 2, act of August 5, 1882, reported as unfit for further service, and recommended to be sold.

Name.	Date of examination.	Remarks.
	1884.	
Colorado	Jan. 16	Appraised value, $34,700.
Niagara	Jan. 30	Appraised value, $24,200.
Florida	Jan. 31	Appraised value, $52,700.
Ticonderoga	Feb. 1	Appraised value, $25,000.
Supply	Feb. 2	Appraised value, $800 (sold to M. H. Gregor for $1,301).
Pawnee	Feb. 6	Appraised value, $5,200 (sold to M. H. Gregor for $6,011).
Oregon	April 2	Recommended to be broken up; second time.
Massachusetts	April 1	Do.
Pennsylvania	April 2	Do.
Colossus and Java	April 3	Do.
Plymouth	June 30	Do.

Vessels examined under section 2, act of August 5, 1882, and recommended for repairs.

Name.	Date of examination.	Remarks.
	1884.	
Pensacola	May 29	Fit for further service.
Richmond	Aug. 29	Do.
Brooklyn	Oct. 15	Do.
Tallapoosa	Nov. 5	Do.
Constellation and Dale	Mar. 22	Examined as to their fittings and repairs. These vessels were recommended to be retained as practice ships only. January 28, 1883.

Special attention is asked to the report of the Board of Inspection and Survey, dated January 4, 1884, on the condition of the monitors Mahopac, Canonicus, Lehigh, Manhattan, Catskill, and Ajax, now at City Point, Va. The hulls and engines of these vessels are in fair condition, but requiring repairs; the boilers of all except the Lehigh and Catskill are old and unreliable. Before any of them could be placed in active service it would be necessary to dock them, overhaul their steering gear, and test their boilers. It is doubtful if the boilers of any of them except the Lehigh and Catskill could be relied upon at all. Thus four out of the six vessels constituting a very important portion of our defensive naval force are not in condition to move with their own steam, and it is not believed that they can be put in condition for even temporary active service until they shall be supplied with new boilers.

If the country depends upon monitors as important elements in the defense of its harbors and cities, it would seem to be a matter of vital importance that they be kept in condition to meet any emergency.

I have the honor to be, sir, very respectfully, your obedient servant,

J. C. P. DE KRAFFT,
Commodore, President Board of Inspection and Survey.

Admiral D. D. PORTER,
United States Navy.

No. 3.—NAVAL ACADEMY.

UNITED STATES NAVAL ACADEMY,
Annapolis, Md., June 7, 1884.

SIR: The Board for the visitation of the United States Naval Academy in 1884 has the honor of submiting this report:

The following gentlemen were members of the Board: Rear-Admiral R. W. Shufeldt, U. S. N.; Hon. Robert C. Schenck, Washington, D. C.; Hon. George H. Pendleton, United States Senate; Hon. Angus Cameron, United States Senate; Hon. S. S. Cox, House of Representatives; Hon. Nathan Goff, jr., House of Representatives; Hon. John H. Evins, House of Representatives; Hon. Dorman B. Eaton, New York, N. Y.; Hon. Stephen M. Allen, Boston, Mass.; Prof. Edward S. Joynes, Columbia, S. C.; Mr. Erwin S. Jewett, Kansas; Mr. William H. Upham, Wisconsin.

Several of them met at Annapolis on the 30th of May, but, no quorum being present, an organization was not made until the next day, when the Board was organized by the election of officers and committees as follows:

President, Rear-Admiral R. W. Shufeldt.

Vice-President, Hon. Robert C. Schenck.

STANDING COMMITTEES.

1. *Conditions of admission and dismissal at the Academy.*—Hon. Dorman B. Eaton, Senator George H. Pendleton, Hon. R. C. Schenck, Prof. E. S. Joynes, Mr. E. S. Jewett.

2. *Subjects of study and standard of scholarship.*—Prof. E. S. Joynes, Hon. J. H. Evins, Hon. N. Goff, jr., Senator A. Cameron.

3. *Grounds, buildings, and sanitary condition.*—Hon. S. M. Allen, Mr. E. S. Jewett, Mr. W. H. Upham.

4. *Seamanship, ordnance, and navigation.*—Rear-Admiral R. W. Shufeldt, Hon. S. S. Cox, Hon. N. Goff, jr.

5. *Discipline, drill, practical exercise, administration, and police.*—Hon. R. C. Schenck, Senator George H. Pendleton, Mr. W. H. Upham.

6. *Steam, mathematics, physics, and mechanics.*—Mr. W. H. Upham, Hon. S. M. Allen, Mr. E. S. Jewett.

7. *English Studies, modern languages, and drawing.*—Senator A. Cameron, Prof. E. S. Joynes, Hon. J. H. Evins.

8. *Finance and library.*—Hon. N. Goff, jr., Mr. E. S. Jewett.

9. *Final report and selection of orator to address the cadets on Friday, June* 6.—Senator George H. Pendleton, Hon. Dorman B. Eaton, Rear-Admiral R. W. Shufeldt.

The committees, after having during several days made careful observation and inquiries concerning the matters respectively assigned to them, separately reported in writing to the Board; and the Board, after considering these papers, gave general directions for the preparation of its report by the committee last named.

I.—CONDITIONS OF ADMISSION AND DISMISSAL.

1. There is an antecedent difficulty which complicates all inquiries relative to the true conditions of admission to the Academy. It springs from the uncertainty, in a legal sense, as to the position of the cadet himself. By admission to the Academy is the cadet admitted to the Navy? Does he become subject to the Navy Regulations, and is he made liable to courts-martial?

The Board was surprised to find doubts among those well informed on these points, and a practice apparently based upon a construction given to the law which seems to answer those questions in the negative. The Board does not feel called upon to express any opinion as to whether that construction of the law could be maintained in the civil courts.

The Naval Academy had its origin, not in any law of Congress, but in the patriotic action of several Secretaries of the Navy, and mainly in that of Mr. Bancroft, aided by various naval officers who were anxious to improve the education of the officers of the Navy. The direct object of the Academy was to educate midshipmen then being inadequately instructed at various places.

These midshipmen were a part of the Navy (Rev. Stat., section 1362). The Academy was at length recognized by statute, and its students were styled cadet-midshipmen (Rev. Stat., sections 1511 and 1513), and cadet engineers were provided for. The patronage of the selection of cadet-midshipmen was in 1862 divided among the Members and Delegates of the House of Representatives, except that the President was to fill eleven cadetships. Subsequently the act of August 5, 1882, put an end to the appointment of cadet-midshipmen and cadet-engineers, and provided for the appointment of *naval cadets*, without defining their relation to the Navy, to the Navy Regulations, or to naval courts-martial. These naval cadets are the students at the Naval Academy, the conditions of whose admission thereto are to be considered. Their legal status is certainly anomalous, and the laws relating to them do not bear evidence of careful consideration.

On entering the Academy these cadets take an oath which contains this language:

> I, * * * having been appointed a naval cadet, do hereby engage that I will serve *in the Navy of the United States* eight years, unless sooner discharged; * * * and I do solemnly swear * * * that I will obey the legal orders of my superior officers and the *rules and articles governing the Navy of the United States.*

Four of these eight years are to be passed at the Academy, the next two years on a cruise which follows graduation, and the last two in sea service as officers in the ordinary course of such service, under the title of Ensign.

The Board has not learned that there is any formal entrance to the Navy, unless it be the taking of this oath and the entering of the Academy. Yet it does not appear that a naval cadet, while at the Academy, is regarded as a part of the Navy. He has taken an oath to support the articles governing and to serve in the Navy; nevertheless he is not regarded as in it, or as entitled to or as subject to the courts-martial for which these articles provide, and which are understood to apply to him on the cruise. On the contrary, Congress thought it needful to enact a special provision, in June, 1874, for making the offense of "hazing" subject to courts-martial. The Board thinks that, by reason of certain of its provisions, this statute should remain, even if it be held that the court-martial system has all the time embraced naval

cadets as being actually a part of the Navy. They are regarded as in the Navy, and for that reason are subjected to courts-martial, while on the last two years' cruise.

The Board also thinks that both legal analogies and the interests of justice and discipline at the Academy require that these naval cadets, like the former midshipmen whom they have succeeded, should while there be regarded as a part of the Navy, and be subject to courts-martial in a form best adapted to the circumstances of the school, and this is the view of the most experienced naval officers whom the Board has been able to consult. Such tribunals could compel the disclosure of facts in cases where their concealment causes distrust and screens the guilty.

It is worthy of notice here that the cadets in the Military Academy at West Point are by law declared to be a part of the Army, and as a consequence are subject to courts-martial, which the Superintendent is authorized to convene. (Rev. Stat., sections 1094, 1317, 1325, and 1326.) There appears to be no reason but the neglect of Congress why provisions which have been found so beneficial at one Academy have not been extended to the other, where they are as appropriate and as much needed. Such a rule has been applied to cadet-engineers at the Naval Academy. (Rev. Stat., section 1525.)

2. The Board ascertained that by the existing system, under which nearly all the patronage of cadet selection for Annapolis is enjoyed by members of Congress, those cadets who have been sent away for fraud and other moral delinquencies are sometimes returned and are again admitted to the Academy, there being no legal authority for preventing it. There is now at the Academy, as the Board has reason to believe, a cadet, sent back there by a member of Congress, who was once discharged for fraud at the examinations. This is an abuse the effects of which cannot fail to be highly injurious.

The law provides that in case any candidate fails to show the proper mental and physical qualifications upon the examinations, he shall not be examined again for that class, and that in case, upon any examination during the course of studies, any cadet is found deficient, he shall not be allowed to remain at the Academy "without the recommendation of the Academic Board." But it does not appear that the Academic Board or the Superintendent has any power to keep out an applicant or to do anything effective for terminating his stay at the Academy, or even for bringing him to trial, however clear the proof of bad conduct, and though that bad conduct be of the grossest character, unless it be hazing. Courts-martial would remedy a part of this evil. But the Board thinks that no person whose connection with the Academy has been severed in consequence of misconduct should be again admitted to it except with the approval of the Academic Board.

The law applicable to the Military Academy contains a provision which is nearly the equivalent of this recommendation. No cadet there reported deficient in either *conduct* or studies, and recommended for discharge, can be returned or reappointed, unless upon the recommendation of the Academic Board, before his class shall have left the Academy. (Rev. Stat., section 1325.)

The Board of Visitors can see no other reasons than the greater difficulties under which the Naval Academy has struggled, and the failure of Congress to provide adequate laws for its protection, why its Academic Board has not secured as ample authority as the Academic Board at the Military Academy for protecting itself from the presence and vicious example of those whose conduct is under condemnation.

3. The Board of Visitors thinks it would be a great improvement to have the selections for the Academy made a year before the time of intended admission, and that the candidates should be examined so seasonably as to be ready to enter the Academy on the 1st of June, or, at latest, during the first ten days of the month.

We have seen that, with the exception of the ten cadetships at large and the one for the District of Columbia, all the places in the Academy are filled by the nominees of Members and Delegates in Congress—one from each Territory and each Congressional district. The statute further provides that the Secretary of the Navy is to fill the places which Members and Delegates do not take the trouble to fill in season. Taking the statute and the legal opinions as to its construction together, it seems to be contemplated that the Members and Delegates should fill their cadetships between March 5 and July 1, and that on their failure to do so the Secretary should have the time from July 1 to September 22 to fill those left empty after July 1. The great disparity between the numbers at the school and the numbers entitled to be there, shown in the figures below, give emphasis to the manifest defects of such a system.

The duty of making such selections being wholly foreign to the functions of a legislator, it is very natural for him to forget or neglect to do it seasonably. During the period for his selection the Congressman is engaged in exacting duties at Washington. In many cases conflicting importunities for the place make a choice very disagreeable.

The Secretary cannot know that there will be a vacancy for him to fill until after July 1, when he may be away on his vacation. Some of those selected decline, and not a few of them, as the tables show, fail to pass the examinations for admission.

If the selections were to be made a year beforehand, there would be time to remedy neglects and fill the places of those who decline or are rejected. Besides, young men, knowing they were to go to the Academy, would give attention to the appropriate studies and enter it better qualified. This would do something toward relieving the pressure of studies upon the time of cadets, which this report will notice.

The law applicable to the Military Academy, apparently recognizing these reasons, requires the appointment of its cadets to be made a year beforehand. (Rev. Stat., section 1317.)

But there are other reasons, which do not apply to that Academy, why the same provision should be extended to the Naval Academy. Instruction for command at sea should be not only scientific but in a large measure practiced in the handling of ships and in all the exigencies of sea-life. Some persons are by nature unable to endure that life. Without experiment the young man from the country cannot know that he is not thus incapacitated. Without going upon the water and getting a view of the vastness of the ocean, having a part in the working of ships and the preparations for fogs, icebergs, and storms, such cadets would enter upon their studies with a feeble conception of the practical value of much which they are called upon to learn.

To meet such needs a cruise at sea is provided for the new cadets, which begins early in June and continues until about the end of August. On this cruise many of the cadets of the older classes are joined with the new-comers, and all work the ship together. Besides the valuable information gained, friendships and associations are formed on these preliminary cruises which greatly influence the whole life of the cadet at the Academy. Perhaps no two months of the whole course of the cadet leaves deeper marks upon him or are of greater value to him. If

he cannot stand sea-life, he leaves the Academy on his return. It hardly need be said, therefore, that those who enter the Academy after this cruise is over begin the course of studies under a serious disadvantage, not merely in point of information, but in forming friendships and relations with members of their own class and other classes. And, beyond this, their lack of what others have learned tends to delay the studies of the course and the advance of the class.

4. In view of such considerations, the Board was sorry to find that year by year, with few exceptions, much the larger proportion of the cadets do not enter the Academy until September or October, when the cruise is over, though such results may be no matter of surprise under the present method of selecting cadets.

In 1883, 94 came for admission in June and 117 in September; in 1882, 44 came in June and 71 in September; in 1879, 2 came in June and 54 in September; in 1876, 85 came in June and 103 in September. The evil is not of recent origin. In 1870, 51 came in June and 102 in September; in 1874, 74 came in June and 106 in September.

In the case of rejections on the September examinations, the vacancies must remain unfilled or the admission of the cadets must be much later. And how numerous these rejections are by reason of physical and mental incompetency may be inferred from these facts: Of the 117 who came in September, 1883, only 61 were found qualified; of the 71 who came in September, 1882, only 39 were found qualified; of the 54 who came in September, 1879, only 35 were found qualified; of the 103 who came in September, 1876, only 48 were found qualified.

These rejections, in the opinion of the Board, are in no degree to be attributed to a standard of admission which is too high. A considerable part of the rejections are due to physical incompetency. In June, 1881, 7 out of 16 rejections, and in June, 1882, 16 out of 21 rejections were for physical incompetency alone.

The literary standard is of the most elementary character, not going beyond the ordinary teaching of the common schools of the country, and the public interest will not allow it to be in any degree lowered.

5. It naturally occurred to members of the Board to consider whether the present system of selections for the Academy is responsible for so many incompetent persons being sent for examination, and whether the examinations cannot be brought nearer the homes of the people, so as to save applicants sure to be rejected the time and expense required for traveling long distances to the Academy in order to be examined.

These points calling for facts not at hand, and requiring additional sessions which the Board was not able to hold, it was arranged that they might be treated in a special report, by such members as might be able to consider them.

II.—SUBJECTS OF STUDY AND STANDARD OF SCHOLARSHIP.

Studies of regular course.—The subjects of study and the hours assigned to each, &c. are found tabulated on page 62 of the Naval Academy Register for 1883–'84, and are more fully explained on the preceding pages. It is difficult to see how the studies proper to such an institution could be better selected, better arranged, or more compactly comprehended within the limit of time possible in the present course of four years.

The studies of the two first years are mainly fundamental; those of the two last years are mainly technical and applied, or professional. It is to be regretted that a larger time cannot be allowed to the more

important subjects of general training; but at present this could not be done without the sacrifice of those technical studies which are essential to the naval profession. The only solution of the difficulty would be either to raise the standard of admission or else to extend the time of general or preparatory study. The first, if it were desirable, is probably impracticable in the present condition of education in this country. The second alternative suggests the question whether, the standards of admission remaining substantially the same as now, it would be practicable to add another year for general study; that is, to make the Naval Academy course *five* instead of *four years*. The Board thinks that such an arrangement, if practicable, would obviate many of the difficulties now attendant upon insufficient preparation, and would give opportunity for more thorough general training, as well as for an easier and more flexible arrangement of time and of subjects throughout the entire course. This question is too difficult to be dealt with in its details by the Board, but we deem it of sufficient importance to demand attention. The Board therefore suggests that the Secretary of the Navy require a report to be made by the Superintendent to the next meeting of the Board of Visitors, setting forth what advantages and disadvantages, if any, would accrue from the extension of the Naval Academy course from four to five years, what changes would thereby be made necessary or practicable in organization, in instructors, or in the course of study, and what would be the additional expense to the Government; and giving an outline of the course as so modified in all departments, and adding any further suggestions deemed proper for consideration.

Special, advanced, and post-graduate studies.—The Board would emphasize the importance of greater opportunity for the development of special, advanced, or elective studies in the later years of the course. The prescribed subjects give a full average of work for the average student. Yet there are other cadets who, by superior industry or capacity, can command time for special work, whether in the line of their special talents or in subjects necessarily excluded from the regular course, or allowed only limited time therein. As, for example, in the higher departments of applied mathematics, physics, &c., on the one hand, or in the German language, which has become almost the vernacular of advanced science, on the other. Herein might be laid the foundation of the highest attainments in scholarship, or of special distinction in technical and professional science in lines directly relating to naval services. The enlargement of the course would give room for special work in these various directions, such as is now possible only in exceptional cases, from want of time and opportunity on the part of both students and instructors. It should be added that the Superintendent and heads of departments now offer every possible encouragement for special studies of this kind, and that, so far as known, they concur in the view that larger opportunity should, if possible, be secured in this direction. The establishment of such special courses would lead, by natural growth, to the gradual development of post-graduate courses, for the pursuit on the part of chosen graduates of the highest departments of science appropriate to the naval service. This Academy should be content with nothing less than the highest results within its own sphere of training. There should be no advantages offered anywhere which this school should not aspire to furnish to its own graduates. Such development can only be the work of time, but the beginning should be made as soon as possible. The first step thereto would be the relief of the crowded condition of the regular course, thus giving scope for such under-graduate special studies as

may be hereafter expanded into established advanced or post-gradu courses.

The force of this remark applies equally to instructors and students. A careful investigation has satisfied the Board that the instructors in this Academy are doing now the utmost amount of teaching that is compatible with personal efficiency.

The admirable system of teaching classes in small sections—never exceeding twelve and generally averaging from six to eight—so advantageous to students, imposes a heavy burden upon instructors, the weight and the value of which can hardly be appreciated without reflection. Such enlargement of the course, even without increasing the number of instructors, would render possible a more flexible distribution of labor, and therewith increased efficiency of instruction within the regular course, in addition to the needed opportunity for special or advanced instruction in the several departments. In aid of such results the Board suggests that the Secretary of the Navy call upon the Superintendent to report such recommendations as he may deem proper for the further development of special or elective advanced courses in the later years of the regular course, looking also to the development of post-graduate courses hereafter for special study at this institution of the highest departments of naval science.

Standard of scholarship.—On this subject the Board has made special investigation, with free access to the records of the Academy and to other various sources of information. In the judgment of the Board, no change is desirable in the present standard of scholarship, whether for admission or for subsequent graduation.

A numerical standard is purely nominal, and at best only approximate. The chief practical question is as to its administration and application. A careful inspection has satisfied the Board that the standards of this school are interpreted and applied with the utmost intelligence and liberality. Nothing more is required than is fairly necessary to the efficiency of the public service. Every reasonable indulgence is allowed, every proper opportunity is offered to make good deficiencies within reasonable limits, and every possible encouragement is offered to the cadet from the beginning to the end of the course.

The records are kept with the utmost fullness, precision, and impartiality, and the standard of scholarship, as well as of merit and demerit in conduct grades, are applied with discretion and leniency. Every student gets the fullest credit for attainment and for conduct, and it is difficult to see what better system could be devised, or how any system could be better administered.

The standard of scholarship for entrance and for graduation as now established and administered at the Naval Academy is deserving of the commendation of the Board of Visitors.

III.—Buildings, Grounds, and Sanitary Condition.

The buildings were all examined, and the Board takes pleasure in stating that it finds that everything practicable has been done during the year to render the premises healthy and comfortable. The condition of the buildings was clean and orderly. Trees have been planted, the grounds have been graded and turfed, and roads and pavements have been made, and they have a very attractive appearance.

The sanitary conditions and general character and requirements have been considered. Particular reference is made to the reports of the Boards of Examiners for the years of 1882 and 1883 for a more perfect

knowledge of the real condition of what then existed and what has since been done on the grounds of the Academy.

The Board thinks it important that all the grounds now owned by the Government, as appurtenant to the Naval Academy, including the site of the hospital and cemetery, should be kept intact, and that no part of them should ever be sold, but that some additions should be made by purchase or condemnation. There should be new and additional quarters provided for the cadets. Quarters should be provided within the grounds for officers now living on the outside.

Grounds.—One of the most beautiful and practically useful parts of the Academy grounds, and now the most healthy, has been reclaimed from the shore of the river, having been filled by débris taken from the higher lands of the Academy.

There is a small tongue of land owned by private individuals which divides the grounds of the Academy on the shore. It has become an unsightly nuisance. This insignificant piece of land is in the way of all general improvement in a connected and practical plan of reform which should be established for future sanitary purposes. This piece of private property is taxed for about $11,000, and should be at once purchased or taken possession of for the use of the Academy.

Hospital farm.—A Government hospital farm, which also includes the cemetery, connected by a bridge across the branch of the Severn with the Academy grounds, will soon be considered an indispensable breathing ground of this institution, for which it is pre-eminently fitted, as well as for other practical uses. These grounds should by all means be retained by the Government. The hospital buildings now upon the premises, but not in present use, if ever removed, should be carefully taken down and the material used for additional buildings for the Academy.

Quarters.—The quarters for cadets at present seem totally inadequate, and are so unfortunately situated as to render a proper plan of general improvement in the future very difficult of execution. The Board therefore recommends a new building for such quarters, in a more healthy spot, adequate in size for future needs. Accommodations for four hundred cadets will be necessary.

The Board recommends that a new *kitchen* and mess-room be erected, entirely disconnected from other buildings. There should be fire-escapes attached to the present quarters of the cadets.

Considerable injustice and inconvenience arise from insufficient accommodations in the officers' quarters. Part of them are in the grounds of the Academy and part outside. This deficiency not only does pecuniary injustice to some of the officers, but is exceedingly inconvenient and injurious to proper discipline. In case new quarters should be made for cadets, the building now occupied by them could be remodeled for additional quarters for officers.

Superintendent's house.—The unnecessary delay for the past two years in finishing the house of the Superintendent has worked great inconvenience; and as the means have already been appropriated for finishing the building, the Board recommends that orders be at once given for its proper completion.

Sanitary condition.—The officers of the Academy have given great attention to sanitary affairs, and are remedying all difficulties as fast as possible. Considering the age of the buildings and their old-fashioned appliances, which were never of the first class, the sanitary condition of the Academy is remarkably good. There is little to complain of not chargeable to the carelessness of the students themselves, through whose neglect offensive conditions are sometimes developed

from which they suffer. It is proper to state that the professors are well informed as to all modern methods of sanitary reform, and are trying vigilantly to carry them out. A perfect sanitary condition, however, cannot be obtained until grounds, buildings, and uses can be practically united in a perfect general system.

IV.—SEAMANSHIP, ORDNANCE, AND NAVIGATION.

It has been gratifying to observe that the present Superintendent has given a merited prominence to these important branches of the naval profession. The cadets are taught to become practical oarsmen, and an exhibition of their skill was quite creditable. It is not many years since naval officers, as a body, were unskilled in this simple but very important accomplishment.

Steam tactics were also well displayed by means of a miniature fleet, consisting of steam-launches, managed entirely by the cadets, and controlled by signals from the flag-launch. The Superintendent informs the Board that by utilizing old sailing launches and unused engines from different navy-yards, he has not only created the present fleet, consisting of eight boats, but hopes to increase this number to twelve, the number actually required for a complete study of fleet fighting under steam.

The method of signaling by hands with flags was also exhibited, by transmitting a message through several stations back to its starting point, without error or delay.

The steamship Wyoming was got under way by the cadets, who performed all the incidental work—steering, sounding, and managing the ship, and, while under way, making, reefing, and furling sails, and sending up and down topgallant and royal yards, all with commendable alacrity and knowledge. The ship was placed under steam alone, with the cadets performing the functions of firemen, machinists, and engineers, and the various duties assigned were well performed.

It must not be understood, however, that, from this cursory exhibition of knowledge on the part of the cadets in these two very distinct branches of the profession, the Board is disposed to approve entirely of the present method of giving to the line officer and the engineer precisely the same course of studies. The results of this system are as yet unknown, with some doubts as to its success; but in the mean while the Board would suggest that the cadets, who, at the end of the academic course are selected for the engineer corps, might by some arrangement be sent to workshops and foundries rather than to sea where they would obtain but little mechanical knowledge of their profession.

The Wyoming is thus employed on the Saturday of every week, and the cadets are taught on board of her, alternately, seamanship and gunnery. The exhibition of target-firing was particularly good. During all of the exercises the Board was impressed with the seamanlike bearing of the cadets and the prompt obedience to orders.

The Board desires to say that in the department of seamanship and ship-building there are needed working models of iron or steel steamships. It ventures to hope they will be supplied in place of those now only applicable to the construction of obsolete wooden vessels.

V.—DISCIPLINE, DRILL, POLICE, &C.

The discipline of the Academy seems all that could be desired, and the many social privileges gained by the good conduct of the cadets is the best proof of the discipline maintained. The most remarkable illustra-

tion is the average of demerit for 1882 and 1883 as exhibited against the average to each cadet during the year just passed. The fall in demerit was as follows:

The first class, from 50 demerit to 3; the second class, from 71 demerit to 38; the third class, from 94 demerit to 58, and the fourth class, from 99 demerit to 48, an improvement without a parallel in the history of the Academy.

The Board highly commends the course of discipline adopted by the Superintendent in producing such results. The last four years the average number of demerit marks has been reduced 50 per cent. against the average number to each cadet for the preceding ten years. The Board is satisfied that the cadets receive severe discipline in case of any infraction of the regulations, whilst accorded liberal privileges in case of good conduct.

The drills, both infantry and artillery, are well maintained, and the cadets are proficient in the maneuvers of both company and battalion.

VI.—STEAM, MATHEMATICS, PHYSICS, MECHANICS.

These subjects have been considered, and the Board approves of the system as taught. The use of steam and its practical application as expounded and illustrated at the Academy cannot fail of giving a thorough mastery of the subjects. It is a great advantage that all are taught practically, whether they enter the engineer's branch of the service or not.

VII.—ENGLISH STUDIES, MODERN LANGUAGES, AND DRAWING.

English studies.—The course of English studies embraces English language; composition and rhetoric; history, general and American, including especially naval history; civil and maritime geography; the Constitution of the United States, and international law.

It is the opinion of the Board that the studies, in view of the objects of the course and of the necessary limit of time, are wisely selected and well arranged, and that they are ably and efficiently taught. The examination questions and answers, which have been freely submitted to the Board, show conclusively that the work in this department is faithfully and ably performed, and with most satisfactory results.

Modern languages.—The studies of this department embrace the French language, and, as an elective study, the Spanish language.

A committee of the Board attended the oral examinations in French, and read the examination papers in both French and Spanish. It pronounces the results of the instruction extraordinary in comparison with the amount of time allowed. This result is largely due to the great advantages of teaching classes in small sections, but also, doubtless, to able and careful teaching on the part of the instructors. It is not too much to say that the progress of the cadets in this department will bear favorable comparison with the best colleges of the country, in proportion to the time allowed to these subjects.

The only drawback to the fullness and efficiency of the instruction in these departments (English and modern languages) is the want of more ample time, both for the studies of the regular course and for such special or advanced studies as might be taken, in the form of *electives*, by students of the higher classes, or as post-graduate studies. It is clear, however—and this view is assented to by the heads of these departments—that no longer time can now be claimed within the limits of the

four years' course. The consideration of an increase of time for these studies, therefore, can profitably arise only in connection with the general question of the enlargement of the course of study.

Drawing.—It appears that the instruction in drawing is conducted on the most approved methods and with ample appliances. This subject is one of great importance, both for its own sake and its application in other branches of science. Great progress has been made in this department in recent years, and the result of its work, so far as the Board is able to judge, is most satisfactory.

VIII.—FINANCE AND LIBRARY.

The Board commends the economical administration of the financial affairs of the Academy, and approves of the excellent system of keeping the finance accounts as adopted by the Superintendent and his able assistants, and also the present system of purchasing supplies by advertisement and inviting bids, whereby a large annual saving is made. The library is in good condition. The increase for the past year has been 700 volumes. The Board recommends that the usual amount yearly devoted to the purchase of new books be continued for that purpose. Every effort should be made to keep the library supplied with the latest and most approved scientific and professional works.

It is but just to add that the members of the Board were promptly furnished every facility they desired for getting at the facts upon all the subjects of their investigation.

The Board thinks that these annual investigations would be made more efficient and useful if some of the members of each Board should serve more than one year. No inconsiderable portion of the short time within which every investigation must be conducted is required to gain that general information concerning the organization of the Academy, the buildings, the courses of study, and the official routine, in reference to which all investigations must be pursued. A few members holding over from a previous year could greatly facilitate the work of a new Board.

This Board, therefore, recommends such a change in the law and practice, in this regard, as will cause the visitors appointed by the President to be classified in such manner as to bring about a holding of their positions for two or three years in succession.

And we are, very respectfully,

R. W. SHUFELDT.
ROB'T C. SCHENCK.
GEO. H. PENDLETON.
ANGUS CAMERON.
DORMAN B. EATON.
EDWARD S. JOYNES.
NATHAN GOFF, JR.
S. S. COX.
STEPHEN M. ALLEN.
E. S. JEWETT.
W. H. UPHAM.

Hon. W. E. CHANDLER,
Secretary of the Navy.

SPECIAL REPORT UPON THE CONDITIONS OF ADMISSION TO THE UNITED STATES NAVAL ACADEMY.

WASHINGTON, *June* 20, 1884.

SIR: The Report of the Board of Visitors, just made to you, shows that it was unable, for reasons therein set forth, to consider the relation which the present method of filling cadetships sustains to the many incompetent persons sent for examination at Annapolis and the numerous cadetships generally vacant, or the question of the need and practicability of bringing the examinations for entering the Academy nearer to the homes of those who wish to enter it.

These subjects were left for a special report, and such a report I now submit.

In that part of the report of the Board which relates to *admissions and dismissals*, important facts are stated which need to be borne in mind in considering the points herein discussed, and, to save repetition, I refer to those facts.

That part of the report shows—

1. That more than half the cadets do not enter the Academy until September, though the public interests and their own progress and advantage while there would be much promoted by entering the Academy as early as the 1st of June.

2. That the standard of admission is not beyond the elementary teaching of the ordinary public schools, that it cannot be lowered without detriment to the public interests, and that a higher standard of education attained before entrance to the Academy would facilitate provisions for a wider and higher instruction which is much to be desired.

3. That all the examinations for admission, which are both physical and mental, now take place at Annapolis, where the applicant, however poor and however remote his residence, must go in order to have the facts of his competency for a cadetship determined. His selection by a member of Congress for examination is regarded as proving nothing on those points, and the examination is decisive.

4. That under the existing system an appointment of a cadet for the District of Columbia and ten at large have been made by the President, with no condition as to the residence and none other as to date. But on June 17, 1878, it was enacted that there should be at the Academy only ten cadets appointed at large.

All the other cadetships are apportioned as so much patronage to Members and Delegates in the House of Representatives, each Delegate being allowed one for his Territory and each Member one for his district; and in case any Member or Delegate does not fill his cadetship between March 5 and July 1 of any year, the Secretary of the Navy has from July 1 to September 22 in which he may fill it from any part of the country.

It would seem that apportionment to districts is, therefore, rather for the convenience of members of Congress than on any ground of utility.

Some of the reasons why such provisions tend to prevent the filling of so many vacancies until September, and the evil effects of this delay, are stated in the Report of the Board.

If the changes which that report recommends shall be made, a considerable part of those evils would be remedied; but such changes would not bring the examinations any nearer to the homes of applicants. They would not prevent so many incompetent applicants traveling long distances and incurring large expenses, which they n bear, before they know they cannot be admitted. To some extent such changes might help the selection of more capable applicants, but they would by no means provide the best practical method for that end. They would not remove the inherent defects or the vicious influences of the present system for the selection of cadets.

Before deciding whether there is any serious need of arresting su evils, it will be well to consider some facts.

1. NUMBERS DUE TO THE ACADEMY COMPARED WITH THE NUMBE WHO ATTEND IT.

There are 325 Members and 8 Delegates in the House of Representatives. One cadet for each and 1 for the District of Columbia, with the 10 appointed at large, gives 344 cadets. But as the President, up to 1878, appointed 10 at large annually, and the course of studi s at the Academy is 6 years, the full number who might have been under instruction at the same time was 394.

Now, the number of cadets actually at the Academy has been less. For example, take the years 1871 to 1874, inclusive, and the average number at the Academy was 243; and coming down 10 years later and taking the years 1881 to 1884, inclusive, the average attendance was also only 243. In 1871 only 200 were present, and the largest number in either of the 8 years was 290. The number of vacancies therefore varies between 104 and 194, the average number of vacancies for the whole 8 years being 150; or, in other words, more than one third of the places which the law contemplates will be filled are left vacant under the present method of selecting cadets. These numerous vacancies, it hardly need be said, mean, the object of the law and the Academy in large measure defeated, ample outfit and expenditures for full classes not utilized, many, perhaps poor young men, deprived of the opportunity of an excellent education, the Government curtailed of its needed chances of securing the best officers possible for its naval service, empty seats and rooms, and meager classes at an Academy liberally supported by a great nation.

A few examples will show how meager some of the classes are. For example, the fourth or entering class in 1871 had but 82 cadets; in 1875 it had but 97; in 1881 it had but 73; in 1882 it had but 47; and in 1883 it had but 85. And only in a single one of those years did the whole number at the Academy exceed 257.

The first or highest class in 1881, 1882, and 1883, respectively, had only 60, 54, and 46 cadets; in 1871, 1872, and 1873, respectively, that class had only 44, 34, and 27 cadets. The average number in the graduating classes for the last thirteen years has been under 55. The-e numbers are more appropriate for a county high school, or a small private college, than for a national institution, among the graduates of which this great republic expects to find its officers for the management of its naval affairs and the command of its ships and fleets.

If it be said that even from so small classes more graduate than can be made officers in the Navy, and that, consequently, no more cadets are needed, the answer is easy.

The weakness and littleness of our Navy are far from suggesting an excess of officers fearless and able for special sacrifice and effort for its up-building. And I trust there are few well-informed and patriotic citizens who do not feel the need that our Navy, both for commerce and for war, should be—and the resolve that in the near future it shall be—made worthy of our country and adequate for its defense; conditions hardly to be reached and certainly not likely to be long maintained without many able and highly educated naval officers.

But beyond this the very object of such an academy and the essential conditions of attaining that object are lost sight of when the classes are so small that the number of graduates very little exceeds the number of naval officers—our future commanders, captains, commodores, and admirals—who must be selected each year from among them.

It is not every cadet who can pass the minimum of graduation who is fit to command a ship, or even to be an ensign upon it. Ability to command is rare. A great and rich people can afford to educate many of its youth for the advantage of a choice of the best of them for naval officers. The lack of the highest order of ability and skill in the commander of a fleet, or of a single vessel during one day even, may involve national dishonor and a pecuniary loss greater than the whole cost of the Naval Academy for a decade.

If the graduating class should contain 150 or 200 as it might, instead of only 27, as we have seen to be sometimes the fact under the existing system, the chances of finding in it 20 or 25 highly competent for officers would be much greater.

It is an incidental effect of every method for selecting the best from many for especial service, where rare qualities are essential and invaluable, whether in selecting a grand jury, the president of a college, or the general of an army—that many must be rejected.

But, in enforcing those tests of attainments, conduct and endurance at the Naval School, which bring the most capable and worthy to the front, it fortunately happens that those cadets who are not foremost—many of them from humble homes—are given an education equally useful to themselves and the country. They may in part supply the great and growing need of more thorough and scientific education for the improvement of our maritime affairs. With reference to these latter considerations alone we cannot afford to have a single needless vacancy at our only Naval Academy.

2. THE NUMBER OF CADETS ALLOWED TOO LIMITED.

But the present system for the admission of naval cadets is not unsatisfactory merely because it allows or compels so many vacancies, but also because it fixes too small a maximum number of cadets at the Academy.

It would not be easy perhaps to decide with exactness upon the most advantageous number for such an institution. The reasons have already appeared why the numbers should be as large as is compatible with good discipline and effective teaching. I have the highest authority for stating that portions of the present outfit are not utilized, and that only an additional number of sleeping-rooms and of teachers are needed to enable the number of cadets to be largely increased. The expense of such an increase would be as nothing compared with the advantages of larger

classes. These reasons make it plain that the present system causes the education of each cadet to cost the Government much more than it need cost.

The present numbers at the Academy are hardly a fourth part as great as are found at our most successful and distinguished institutions of learning, to say nothing of those of Europe. I have been able to find no intrinsic objection to having as many as 500 or 600 at the Academy. Such numbers would have the incidental effect of adding largely to the vital and sympathetic connections of the Academy with the people, and would increase its prestige and dignity in their eyes, as well as in the estimation of the cadets themselves. With even a more exacting course of study classes of not less than 100 would then graduate.

I am unable to find any reason for thinking that the present maximum limit of cadets was fixed either upon any adequate consideration of the importance of the Government having a very large number of graduates from whom to select the best for officers, or upon any definite theory as to how many could be most economically or thoroughly instructed at the Academy.

For the convenient and equal distribution of the patronage, or perquisites of selecting cadets among Members and Delegates in the House of Representatives, it is plain that to give one or two or three or more to each Delegate was natural, if not necessary. That necessity of the system perhaps dictated the maximum number allowed. But it is too plain for argument that there is not the remotest natural relation between the fit number of members in a legislative body and the fit number of cadets in a naval academy.

On the other hand, nothing is more fit than to disregard and forget everything like patronage, perquisites, and favoritism in determining the number, character, and qualifications of the young men who are alone examined for such national schools as those at Annapolis and West Point. The selection for admission there predetermine and circumscribe those who are, in the most responsible places, in future years to command on land and sea, and to whom therefore the honor and safety of the nation must be most directly committed in times of peril. The very instincts of self-preservation declare the right and the duty of the Government to first bring into these schools as many as practicable of the most promising for such high trusts among all the young men who wish to enter them, and next to select for officers from among the whole number educated there those who, tried by the highest standards, shall have proved themselves the most worthy and able for command. To act upon any narrower or more selfish motives is a crime against the country. To make official perquisites out of selections for such schools is a prostitution of legislative authority.

3. INCONVENIENCES OF THE PRESENT EXAMINATIONS AND THE CONSEQUENCES.

The selection of a young man by a member of Congress for a cadet decides nothing except that he is to have the exclusive privilege of being examined to see whether he is competent. The favorite selected has the monopoly of being examined from his district. All other aspirants for the place, however much more worthy, must stand aside while the favorite tries to get into it; and if he fails, it may remain unfilled. The examinations are all conducted at Annapolis and extend to both physical and mental qualifications. The sending of the young man there is not regarded as even presumptive evidence that he is qualified in

either particular. The designation by the Congressman merely gives the monopoly for his district from March 5 to July 1 of the privilege of being examined; in other words, no one but the Congressman's favorite can be examined during that period. If the designated person fails at the examination, or declines to attend it, that monopoly attaches from July 1 to September 22 to the appointee of the Secretary of the Navy. The young man selected for examination, however limited the means of his parents and however remote their residence, must go all the way to Annapolis to learn whether he has the essential mental or physical qualifications for admission to the Academy. The figures show it to be certain that fully one-half of those who go will fail to pass the entrance examination. The parents of the young men must bear their expenses if they make a failure, and they are all the more humiliated by reason of the conspicuousness which the journey has given to that failure. It would not, I must think, be easy to devise a system which should be at the same time more unjust, more undemocratic, and more certain to cause vacancies; and therefore to prevent a large part of the possible benefits of such an institution.

It does not need the citation of examples to make it plain that the young man who has made the long journey from Oregon, California, or Texas, and really falls, but not greatly, below the standard of admission, physically or mentally, is very likely to be accepted rather than subject him and his parents to such humiliation and expense. If he is admitted, the Government pays that expense. However conscientious examiners may be, they must find it practically impossible to sternly apply the standard in such cases. It hardly need be suggested that what influence his patron—the Congressman who selected the young man—may have is quite sure to be exerted vigorously in his behalf. These elements of the existing system plainly, constantly, and strongly tend to lower the standard of both mental and physical capacity for admission, some of the consequences of which will appear in figures soon to be given.

It should be here noticed further that such conditions of admission are unfavorable to parents in humble circumstances. It may have strained their resources to the utmost to educate their boy, or they may have declined to attempt it because they could not afford the expense of his journey in case he should fail at the examination.

The records of the examinations strongly emphasize some other consequences of this monopoly of the privilege of being examined. A few examples of the numbers admitted and rejected in a year will illustrate my meaning. In June and September, 1876, 188 persons applied for examination, of whom 12 were rejected for physical incapacity and 81 for mental incapacity. In 1881, in those months, 86 applied, of whom 21 were rejected for physical incapacity and 24 for mental incapacity. In 1883, in those months, 211 applied, of whom 21 were rejected for physical incapacity and 69 for mental incapacity. That is, out of 485 young men who had traveled from their homes to the examinations at Annapolis in these three years, 54 were rejected as physically unfit and 174 as mentally unfit. In other words, 228—or nearly one-half of the whole number who applied—were found to be incompetent! How many of them had journeyed more than a thousand miles at their parents' expense to find out that they were physically incompetent I am unable to say, but such was certainly the fact as to several of them.

From such facts we may imagine the mortification, the loss of time, and the great expense in the aggregate which the present system causes;

and, I must think, without the least compensating advantage over a system that would be at once convenient, just, and relatively inexpensive.

But these figures are in other aspects suggestive. They make it plain that selections for examination under the present system are generally based on no personal scrutiny, and consequently that they are controlled by considerations, in great measure at least, regardless alike of the merits of the applicant, the interests of the country, and the needs of the Academy.

In any view of the matter it seems to me quite impossible to defend a method of selecting cadets, the results of the enforcement of which are that nearly or quite one-half of all the boys who are sent to the gates of this National Academy are returned to their parents and patrons as being unfit for entering it.

Why should such a method longer prevail? Why should not the examinations be opened to every young man who seeks to enter them for the purpose of winning his way upon his own merits to a place in the official service of his country? Is it any part of the object of this Academy to make places for the favorites or *protégés* of any class of public officers? On what principles of justice or policy, if politics or favoritism be not the basis of selecting cadets, can a young man who applies to have his capacity tested at the examinations be turned away merely because he is not recommended by the Representative of his district, with whom, perhaps, the political or social relations of his father are not favorable?

There are other facts in the records of the examinations hardly less significant, as showing that the present system brings many incompetents not only to the examinations but into the Academy.

It is doubtless inevitable that in a course of study and discipline so exacting as that at Annapolis the classes when they graduate should be considerably smaller than when they enter. But the difference in numbers at these periods seems to be too great to be accounted for on any other theory than this—that the examinations are so lenient as to let in some who should have been excluded.

For the ten years, 1871 to 1881, the average number each year in the fourth or entering class was 104, while the average number in the graduating classes was only 54; in other words, not only are one half of those examined incompetent to enter, but almost one-half of those admitted are unable to graduate.

There are, of course, some resignations as well as expulsions from causes other than a lack of mental or physical capacity; but those included, it thus appears that only one in four of those that go to the examinations are able to get through even the first four of the six years of the course. If the gates of these examinations were open to all who offered themselves, instead of being closed against every one but the favorites of members—or of some of their constituents whom they do not care to offend—and more especially if the examinations were conducted in different parts of the Union, I must believe that superior candidates would appear and that fewer vacancies would exist at the Academy.

4. THE TRUE BASIS OF SELECTIONS FOR THE ACADEMY.

It is for various reasons wise to take care that the cadets, both at the Naval and Military Academies, come from the different sections and States as near as may be in the ratio of their population. But cadets are not, like legislators, representative officers. They have not,

as cadets or officers of the Army or Navy, any special duty to look to the interest of any Congressional district. It is not desirable to develop in them any district or sectional patriotism which shall subordinate that which comprehends the whole country. A Congressional district is intrinsically no more appropriate than a county or a judicial district as a basis for selecting cadets.

If each of the States gets its proportion of the cadetships, there seems to be no need for making it an indispensable condition that each Congressional district shall have one at the peril of a vacancy in the quota of a State. Indeed, the law is as inconsistent with itself as it is difficult of execution, in first requiring that from March to July all selections must be made on the basis of one to a district, who must be a resident thereof, but next allowing, from July to October, the selections to be made by the Secretary of the Navy, like those made by the President, without regard to districts or even to States or sections.

The theory that any public interest requires members of Congress to make the selections is repudiated by the facts last cited, as it is also by the law relating to cadets for the Military Academy; for that law, in direct terms, requires the President to make all the selections for examination.

It hardly need be pointed out that the appointment of cadets, like all other appointments, is in its nature an executive and not a legislative function. A member of Congress has not, like the Secretary of War or of the Navy, any special opportunity or duty of knowing the needs of these Academies. In June, when the appointments should be made, he is, and has been for seven or eight months, in Washington overworked and perplexed by the vast demands of legislation, for which more time and thought than members have given to it are imperatively needed.

How can he decide whom to send to Annapolis unless he takes a personal favorite, or balances, as he may, after a tedious correspondence, the claims of importunate friends and exacting constituents?

But, has he a right to take a favorite of his own or of his social friends, or of his political supporters, and thus exclude a more meritorious boy? May he give the place to one of his own political faith rather than to a more promising boy whose father adheres to the other party? Is it right to consider who voted for him at the last election and who can influence most voters at the next election, in deciding who shall be sent to Annapolis to be examined? If yea, then places at the National Academy are the selfish patronage and perquisites of Congressmen; if nay, why adhere to a system which suggests and facilitates such abuses? The records of investigations, which have disclosed in several instances the sale or barter for votes of selections for one of these Academies, make it needless to ask questions of a graver kind.

It is not to be doubted that most members of Congress make a conscientious use of their power of selection, or that they find it very troublesome. But why do so many others covet that power? Why is the opinion so general that it is exercised in the spirit of favoritism, as if it were an official perquisite and not a public trust?

The public protest against the secret and selfish exercise of that power, and the sense of duty on the part of the members to select the most worthy—steadily growing stronger—have more and more in later years united in causing some form of examination to be extemporized in the districts, for the double purpose of avoiding criticism and of securing the most meritorious from among all those wishing to go to the Academy. But the methods of these examinations have been so de-

fective, there has been so much distrust of their impartiality, and their standards have been so low and inappropriate, that they have fallen far short of the results which a good system of local examinati would insure. Neither the physical nor the mental tests have be those applied at Annapolis or West Point, whether in kind or degree. The examiners are often without experience and the notices inadequate. The methods and details of the examination have been as diverse and peculiar as the views of members and the habits of the localities.

There are yet other reasons why a system of open and free examinations should take the place of the present system of patronage and monopoly.

1. The right or claim of every young man to have a place in an Academy supported by the nation is not measured by his standing or influence with the member of Congress for his district, but by his physical and mental capacity and promise for the service of the country. To refuse all opportunity for testing this claim of capacity and promise at the examinations—except on the part of the single person whom a member chooses to allow to go there—is a wrong to all other aspirants and a loss to the country. It is more in the spirit of feudal despotism than of republican justice.

2. The whole theory upon which rank and precedence are based at the Academy, and according to which offices and promotions are conferred after the course there has been completed, is that every one must make his own way and win his rank for himself solely upon his own merits.

Congressional favor and official influence behind count for nothing. No one will pretend that a member of Congress should be allowed to select those who alone are to be allowed to be examined for promotion. But why not, on the theory which allows him to say who alone may be examined for admission?

If five or ten young men from a Congressional district wish to compete for the privilege of entering the Academy, why should their Congressman decide that only one shall be examined? Does not the Government prefer the most meritorious, and has not that one the strongest claim? If it be said that it is to be presumed that the Congressman selects the best, then, I ask, why does not his selection give entrance to the Academy and not merely admission to the examination at its gates? It is simply because his selection is recognized as not adequate for determining who of all applicants is the best, or even fitness for entering the Academy at all, that the examination is made the sole test for admission. Therefore, personal right, the public interest, and the whole theory of grades at the Academy alike require that the examination should be open to all. It is too plain for argument that the same principle which gives the best in the competition of the classes the highest honors and the first offices, and which all along the whole line of active service makes promotion dependent upon personal merit, also requires that the most competent applicants in a State should be able to secure admission for the simple and single reason that they are the most competent.

3. The present system says to every young man—

The filling of the Naval School with cadets is a perquisite of certain great officers, and your prospect depends primarily upon your parents' standing well with your member of Congress and not on your own merits. Your chances, except in the cases where members stand absolutely for that common justice on which all open, free examinations rest, do not depend on your showing more capacity than any one else wishing to enter the Academy from your district or State, but on your bringing more influence

to bear upon your member. He opens and shuts the gates of the examinations for reasons of his own. Consider these reasons. Above all things make sure you are his favorite.

And thus, at the very opening of his career, the future officer of the Navy is taught the pernicious lesson—which the whole course in the Academy may not obliterate—that office and favor in the Navy, at least so far as members of Congress are concerned, go not according to merit, but according to influence. All young men outside the favorites who are denied the privilege of competing at the examinations are also taught the same lesson.

Many a cadet has abundant reason to believe that, if there had been an open competition of merit in his district or State, some other more capable applicant than himself would have gained the prize of a cadetship. In that feeling, there is danger that he will be obsequiously grateful to his member. On the other hand, the cadet expects—and too often not without reason—that his member will not allow him to be rejected at the examination if he can prevent it, or to be brought to any very serious account for his delinquencies. He appeals to his Congressman against the Academic authorities when he is arraigned for offenses. It need not be said that this is highly prejudicial to discipline.

I must go further and add that I regard it as a detriment to the public interests to have members of Congress hold any such personal relations to the beneficiaries of a national academy. They should sustain a common relation of impartiality to every cadet. They should be subject to no bias and affected by no pride or public sentiment which inclines them to the care of one cadet rather than another. The proper relation is not that of client and patron. The cadetships in both Academies, dissevered from all ideas of official favor and patronage and brought to strict tests of personal merit, should be regarded as honorable prizes for which every young man, with courage, aspiration, and patriotism enough to enter himself against all competitors, should be at liberty to make an effort to win in a free, open, manly examination.

Why should a member of the House of Representatives, any more than a senator, a governor, a mayor, or any other officer, be allowed to stand between the citizen and the examination, and say, "None but those I have ticketed shall attend these examinations"? Why should the conditions of entering the great fighting professions of the country be made favorable to the class most assiduous and obsequious in those devotions which too often win the favor of high officials, rather than to the bolder and more self-respecting class of young men who would go unaided to the examinations, if the feudal barrier of Congressional consent were removed, but who refuse, or whose parents refuse, to resort to cringing or unmanly solicitation for the privilege?

It is much to be desired, when the cadets look into the faces of each other on parade, that they should see, not *protégés* admitted to the examinations by the favor of great officers, and constantly protected by them—not persons who disclosed merely the capacity for rising above a minimum grade at the examinations—but young men who came forward unaided, who have demonstrated their superior capacity in a free, open test of merit, and who have held the places they won without the aid of a patron at court. No Congressman or other great officer, under a true system, could look at one of the cadets and say, "You are my man; I put you into the Academy"; for each of them, under free competition, would win his place for himself, and would be the cadet and the officer of no one but his country and his whole country.

5. THE PRESENT SYSTEM UNCONSTITUTIONAL.

But there is another very different but very decisive reason why the present method of selecting cadets for the Naval Academy should come to an end. It is founded in a usurped authority in violation of the Constitution. The cadets at West Point and Annapolis alike are "inferior officers" in the view of the Constitution, and their appointment is an executive and not a legislative function. The Constitution declares that Congress "may vest the appointment of inferior officers in the President alone, in the courts of law, or in the heads of Departments"; but Congress has no authority or right to take such appointments to itself or to distribute them among its own members. It might as well thus distribute all the appointments to the Departments and custom-houses.

Even if originally a plausible claim could have been made that the selection of a cadet was not in legal effect an appointment of an inferior officer within the meaning of the Constitution, Congress has by its own action condemned that claim. For, treating cadets at West Point as such officers, Congress has, under the clause of the Constitution just cited, vested their appointment in the President alone (Rev. Stats., section 1315). And even in the very section of the statute (section 1514) in which that clause is violated by Congress usurping for its own members the appointment of nearly all the naval cadets, the President is allowed to appoint eleven of them, and the Secretary of the Navy is, by appointment, to supply cadets for all the vacancies which Congressmen leave unfilled. Not only, therefore, are two repugnant theories of the Constitution declared in the provision for selecting c dets for the two Academies, but both these repugnant theories are enforced in the single section of the act relating to the Naval Academy.

It is true that the latter section, which is remarkable for its inaccurate and careless phraseology, only says that the "nominations" shall be made (without saying by whom) "on the recommendation of the member or delegate." The intention, however, which the practice has followed, was that nomination included appointment and that the recommendation limited and should practically control both. In other words, the Congressman's recommended favorite alone may be appointed from March to July, as before explained.

6. EXPERIENCE HAS CONDEMNED SUCH PATRONAGE.

But even if the member was held to have only usurped the power of nomination, that would be equally repugnant to the Constitution. The appointing power cannot be thus divided and parceled out between executive and legislative officers. If members of Congress may limit the appointment of cadets to persons they recommend, they may in the same manner and for the same reason limit the appointment of consuls, judges, and ambassadors. The only justifiable division of the appointing of that kind is that declared in the Constitution itself in conferring the power of confirmation upon the Senate. No such power is anywhere allowed to members of the House.

The question of the patronage of these cadetships relates only to a fragment of the old perquisites and spoils, a great mass of the civil part of which, covering more than 14,000 appointments, was taken away by the civil service act of January 16, 1883. The filling of all those places—before in substance apportioned to members of Congress—is by that act made dependent upon free, open, competitive examinations, held in the several States, and with great and recognized advantage to the public

service. On the 7th of the present month, a committee of the House of Representatives, after a very thorough investigation, in a unanimous report approved and commended the examinations now being conducted under this law.

During many years, Great Britain has enforced such examinations at the gates of her military schools, by which their standard and their character have been elevated. They have been tested for more than a decade both in the home military and civil service and in that of British India, with like results. For the Royal Military College, the Royal Military Academy, the Royal Marine Artillery, and the Royal Marine Light Infantry, such examinations were several years since made the conditions of admission.

There appears to be no good reason why we should not profit by her example, by consistently acting on our own precedent in the civil service. I feel confident that most members of Congress would be glad to be relieved of the annoyance of making these selections. That the administration of the Academy would be made easier, and that the capacity and attainments of graduates would be higher, under a system based on personal merit and common justice, I cannot doubt. It is impossible that a selfish and feudal test shall be long continued for the Army and Navy, now that such a system has been condemned in the civil administration. There is no more reason why cadetships at the Academies at West Point and Annapolis should be open only to the *protégés* or nominees of members of Congress than there is why clerkships in the War Department and the Navy Department should be open only to such *protégés* and nominees.

7. THE APPROPRIATE EXAMINATIONS.

It is hardly appropriate to enter into details here concerning the practical methods of these examinations. With proper adaptation to the peculiar needs of the Academy, they could follow closely upon the precedents which have been so successful, on a vastly larger scale, in our civil service.

The following fundamental conditions will be a sufficient illustration of the proposed system:

1. Appointments to cadetships should be apportioned to the States according to population (allowing one to each Territory and one to the District of Columbia), with conditions, if deemed wise, in the interests of Congressional districts as hereinafter mentioned.

2. The examinations should be seasonably held at such parts of the Union as will accommodate one or more States, without requiring applicants to travel unreasonable distances; but those residing not too far from Annapolis could still go there to be examined. Examinations could be held at one or two places in New England, and at as many in California and Texas, for example.

3. There should be an appropriate form of application for an examination, in which the applicant should be required to set forth under oath his age, residence, nationality, education, and such facts covering his mental and physical capacity, and his history, accompanied with proper vouchers for his character, as would altogether show him to be apparently qualified for admission to the Academy. Neither any influence nor any recommendation on the part of any member of Congress, governor, mayor, party manager, or other prominent person should be required for making this application. But such officers, like other citizens, could advise friends to make an application and take their chances with others in a free, manly way.

4. The tests and questions for these local examinations, whether relating to physical or mental qualifications, should be prepared by and applied according to the directions of the Academic Board of the Academy, subject to any proper supervision by the Secretary of the Navy. They should be of the *same kind and grade* which would be used if the applicant was examined at Annapolis. Those who failed to pass above a prescribed minimum grade should be held ineligible to admission, precisely as they would be if examined at the Academy; and there could be just provision for re-examinations in proper cases.

Local examinations of this kind are being yearly held by our leading universities for the admission of students under uniform methods, and with complete success. But a New York journal of to-day records the suspension of an extemporized Congressional district examination there for the Naval Academy because it was not known whether algebra should be included!

The quota of a State should be filled by selecting the highest in grade (under a proper combination of the mental and physical tests) from all those who competed from the State. If the distribution of cadetships among the Congressional or judicial districts of a State should be thought more important than to secure the most meritorious applicants from the whole State, an applicant from any district who has passed the minimum grade for eligibility could be given a preference over candidates from other districts of the same State although they have shown superior qualifications.

5. A medical officer in the service of the United States near the place of examination or, what would be preferable, such an officer from the Academy, with one other officer therefrom taking the questions should attend the examinations. The answers upon the papers prepared at the Academy would be taken back there by the examiners. The papers would be marked and graded at the Academy from whatever States the applicants came; and thus complete uniformity and justice would be secured. Except those near at hand who went there for examination, only those finally appointed for admission would need to go to Annapolis at all.

6. In case of vacancies occurring at any time after the annual examination, those on the examination-lists should be eligible, in the order of their standing, to fill such vacancies.

7. To meet the technical need of an appointment, the Secretary of the Navy should be required to appoint those graded highest on the examination-list according to clear rules, subject to which all the examinations should be conducted, as he now appoints clerks for his Department.

Under such a system, which would make both the Military and the Naval Academies truly representative of the freedom and justice of our institutions, which would open them to all classes and all parties alike, which would exclude patronage, favoritism, and monopoly by making cadetships the prizes of superior personal merit, which would bring the methods of gaining admission to those institutions into harmony with the methods now being enforced for entering the departments to which the Academies are subordinate, I am persuaded that cadets of superior qualifications would be secured, that the Academies would stand higher in public estimation, and that members of Congress and the President would be relieved of much annoyance in the dispensation of apatronage which is not only indefensible upon any sound policy, but is mischievous in all its effects.

DORMAN B. EATON.

I concur most heartily in the general spirit and in most of the conclusions of Mr. Eaton's special report.

GEO. H. PENDLETON.

I concur in the arguments and general conclusions of Mr. Eaton in the foregoing special report. It cannot be doubted that the existing system of admission to the Naval Academy is open to very strong objections. Any new system adopted should of course be subject to the approval and control of the Superintendent and Academic Board of the Academy.

EDWARD S. JOYNES.

We concur in Mr. Eaton's special report.

W. H. UPHAM.
STEPHEN M. ALLEN.
E. S. JEWETT.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy.

REPORT OF THE SUPERINTENDENT.

UNITED STATES NAVAL ACADEMY, ANNAPOLIS, MD.,
November 1, 1884.

SIR: I have the honor to report that during the past year the prescribed course of instruction has been carried out; that forty-six cadets completed the four years' course in June last, five "with distinction" and twenty-five "with credit," and were detached from the Academy to perform two years' service afloat. Twenty-five of this class entered as cadet-midshipmen, and twenty-one as cadet-engineers.

The usual summer practice cruise was made by the cadets of the first, third, and fourth classes, in the sailing ships Constellation, and Dale. Copies of the reports of the commanding officers of these vessels are forwarded herewith, marked A, and B.

The cadets of the second class were retained at the Academy during the summer and daily instructed in mechanical work in the shops of the department of steam-engineering; they were also instructed in running and managing steam-launches, managing boats under oars, and under sails, signaling, steam-fleet tactics, howitzers afloat, target practice with mortars, machine guns, rifled howitzers, and great guns.

Necessary repairs and improvements have been made to the public buildings and grounds as far as practicable during the year.

Eighty-three candidates for admission presented themselves in May and June last and eighty-one in September. Of this number one was over age, one withdrew, one was refused examination, fifty-two failed to pass the requiredmental examination, and twenty-five were rejected for physical defects. The physical defects of nine were waived by the Department. Ninety-three were admitted and appointed naval cadets.

Experience has shown that cadets who enter the Academy in May gain a great advantage over those who enter in September, and I therefore respectfully recommend that hereafter all nominations of candidates shall be made by the 4th day of March, and that all candidates for admission shall be required to present themselves for examination

between the 15th day of May and the 1st day of June. This wo necessitate a modification of section 1514, Revised Statutes.

I also respectfully renew the recommendation made in my last report, that it will be beneficial to the Navy and to the cadets, and a saving of expense to the Government, to so modify the act of August 5, 1882, that the selection of cadets who are to fill vacancies in the lower grades of the line and Engineer Corps of the Navy and of the Marine Corps, shall be made upon the completion of the four years' course, instead of upon the completion of the six years' course.

I am, sir, very respectfully, your obedient servant,

F. M. RAMSAY,
Captain, U. S. Navy, Superintendent.

Hon. W. E. CHANDLER,
Secretary of the Navy.

CRUISE OF THE CONSTELLATION.

UNITED STATES PRACTICE SHIP CONSTELLATION,
Annapolis, Md., August 31, 1884.

SIR: I have the honor to submit the following report of the practice cruise of this vessel, officered as follows: Commander N. H. Farquhar, commanding; Lieut. Walton Goodwin, executive officer; Lieut. John F. Meigs, navigator; Lieut. E. H. Gheen, watch officer; Lieut. E. B. Barry, watch officer; Lieut. H. O. Rittenhouse, watch officer; Lieut. J. C. Cresap, watch officer; Ensign A. E. Culver, assistant to instructor in navigation; Paymaster Theo. S. Thompson, Surgeon John C. Wise, P. A. Surgeon J. M. Murray, Chaplain A. A. McAlister.

On June 9, 109 naval cadets, as follows, first class, 20; third class, 41; fourth class, 48, were embarked.

June 16. Sailed from Annapolis and worked down the bay, anchoring at night; finally reached, Fort Monroe June 23.

June 25. Sailed from Fort Monroe, but on account of bad weather anchored in Lynn Haven Bay until next day.

June 26. Took departure from Cape Henry and stood out to sea, running southeast to Gulf Stream, thence gradually working north; reached Portsmouth, N. H., 9 p. m. July 16.

In Portsmouth the ship was moored alongside the navy-yard.

Rear Admiral C. H. Wells, commanding, and the officers of that station, did everything to make our stay agreeable and instructive for the cadets. The dry-dock, various shops, and store-houses were visited, and everything explained to the young gentlemen by those in charge.

The ship was detained several days by the honorable the Secretary of the Navy, in order that the officers and cadets might participate in the reception ceremonies of the Greely Relief Expedition on shore. The naval cadets went as an infantry battalion, in charge of Ensign W. F. Fullam, and presented a very creditable appearance. The entire naval force of 1,200 men, consisting of naval cadets, marines, seamen, and apprentices, was placed under my command.

August 6. Sailed from Portsmouth, reaching the bay August 12, and finally Annapolis August 28.

The weather in Portsmouth was cool and bracing, and I think we were all benefited thereby. At sea, both in going and returning, continuous damp weather, squally, and rains, unusual in these latitudes; on several occasions we were days without observations of the sun. A

moderate gale from the north was experienced at the start; the sea, somewhat rough, made almost all the cadets sea-sick for a few days. It also rained most of this time, which did not make it more comfortable. Much fog was also experienced from Cape Cod to Davis's South Shoal.

The routine laid down in the instructions has been carefully carried out. The first class have in turn performed the duties of captains of the top, officers of tops, officer of the forecastle, quarter-deck duty, and mates of gun and berth decks, officers of boats, and frequently in charge of the deck. They seem to be timid aloft.

The third and fourth classes have been doing seaman's and ordinary seaman's duty (except cleaning ship), standing watch and watch at sea. Both classes have made progress; some of the fourth-class men, who at first were backward, have become good topmen. At first the fourth class were not stationed aloft, but since leaving Portsmouth many have been so stationed at their own request. As a rule, the light sails are almost entirely handled by the cadets.

In addition to the usual exercises and signal drill the following course of instruction for each week has been carried out:

Week ending June 21, 1884.

First class.—Will make a note and submit on Saturday, the manner of bringing to a chain, heaving up, catting and fishing an anchor, and securing for sea.

Third class.—All standing rigging, manner of fitting, and order in which it goes over mast-heads. Sketch a lower mast-head.

Fourth class.—Parts of the ship, masts, yards, and sails. Name the gear of a topsail and describe its use.

Week ending June 28.

First class.—Will make a note and submit on Saturday the method of hoisting in a steam-launch, securing yards, &c.

Third class.—Reeve running rigging.

Fourth class.—Name the gear of courses and light sails; describe use and where belayed on deck. Knot a ropeyarn; tie a bowline; running bowline and bowline on a bight; a reef knot; a half hitch; rolling hitch; timber hitch; clove hitch, and marling hitch.

Week ending July 5.

First class.—Will make a note, and submit on Saturday, "reefing topsails."

Third class.—Anchors and chains.

Fourth class.—Standing rigging.

Week ending July 12.

First class.—Will make a note on tacking and wearing.

Third class.—Securing anchors, ready for letting go, and for sea.

Fourth class.—Standing rigging (repeated). Make a wall-knot; double wall and crown; Mathew Walker knot; sheet bend; carrick bend.

Week ending July 19.

First class.—Will make a note on Portsmouth navy-yard, describing parts visited.

Third class.—Make a sketch of "head booms," showing order of rigging.

Fourth class.—Make a sketch of jib and spanker, naming parts and gear.

Week ending July 26.

First class.—Will make notes on navy-yard, describing parts visited.
Third class.—Make a sketch of mainyard; describe bringing chain to capstan.
Fourth class.—Make a sketch of a topsail, naming parts and gear.

Week ending August 2.

First class.—Will submit notes on navy-yard, describing parts visited.
Third class.—Sketch topmast head, showing doublings of mast and order of rigging. Describe reefing topsails.
Fourth class.—Sketch a mainyard with mainsail, showing and naming gear.

Week ending August 9.

First class.—Will submit notes on bending and unbending sheet chains.
Third class.—Reeve studding sail gear. Make up a topsail for bending.
Fourth class.—Nomenclature of VIII-inch gun and carriage. Make an eye-splice; short splice and long splice.

Week ending August 16.

First class.—Setting and taking in studding sails.
Third class.—Make a sketch of starboard foretop-gallant, topmast, and lower studding sails, showing lead of gear.
Fourth class.—Compass, lead, and log lines.

Week ending August 23.

First class.—Transporting a sheet anchor.
Third class.—Tacking and wearing, with compass questions.
Fourth class.—Give stations and duties of an VIII-inch gun's crew at "cast loose and provide," "worm," "parcel," and "serve."

In navigation, taught to the first class only, much has been done, as you will see from the following schedule of work:

June 16, 17, *and* 18.—The adjustment and use of sextant; use of azimuth compass. Each cadet took cross bearings three times daily while under way and once while at anchor, and plotted ship's position on chart. Observed bearing of ☉, and found compass error by time azimuth.

June 19 *to June* 23 (*Chesapeake Bay*).—Exercised daily in fixing ship's position by three-point problem; angles taken by sextant; astronomical triangle and definitions in nautical astronomy explained. Each cadet constructed a Mercator chart of the bay and explained its construction. Worked time azimuth for compass error.

June 25.—Plotted ship's position; worked time azimuth for compass error; instructed in different sailings.

June 26 (*Lynn Haven Bay*).—Found course and distance to Nantucket Light.

June 27 (*at sea*).—Worked dead reckoning and meridian altitude of ☉.

June 28, 30; *July* 1, 2 (*at sea*).—Day's work daily (a. m. or p. m. time), sight for longitude, meridian altitude ☉, and dead reckoning. Abbreviations and uses of charts explained.

July 3 (*at sea*).—Sumner's single line of position, cir. cum. meridian altitude ☉.

July 5 to *July* 8 (*at sea*).—Meridian altitude ⊙ daily. The following sights were worked out: For latitude cir. cum. meridian altitude ⊙, meridian altitude ☾, altitude of * Polaris; for longitude a. m. and p. m. time sights ⊙, time sight ☾, and time sights of * ς Arcturus and Spica.

July 9 (*at sea*).—Sumner's double-line position by two a. m. time sights, meridian altitude ⊙.

July 10 (*at sea*).—Sumner's double-line position by simultaneous observation of ⊙ and ☾ for longitude. Meridian altitude ⊙.

July 11 (*at sea*).—Sumner's double-line position by simultaneous observations of two stars for longitude. Meridian amplitude ◉, and amplitude of ⊙ for compass error.

July 14 (*at sea*).—Sumner's double-line position by a. m. and p. m. time sights ⊙; meridian altitude ⊙.

July 15 (*at sea*).—Same; also time azimuth for compass error.

July 16 (*at sea*).—Same.

July 17 *to August* 4 (*Portsmouth, N. H.*).—Each cadet worked out a sunset table for the port, found the time of high water and the time the sun crossed the prime vertical on different days, and took two observations with sextant and artificial horizon for chronometer-error and rate. Instructed in sailings and advantages of Sumner's lines.

August 6 (*Portsmouth, N. H.*).—Found course and distance to Cape Henry by Mercator and middle latitude sailing.

August 6 (*at sea*).—Sumner's double-line position by 2 a. m. time sights meridian altitude ⊙.

August 7 (*at sea*).—Sumner's double line by two observations for latitude φ' and φ'' method meridian altitude ⊙.

August 8 (*at sea*).—Sumner's double line by one observation for longitude and one for latitude φ' and φ'' circum meridian altitude.

July 11 (*at sea*).—Same; also amplitude of ⊙ for compass error. Whenever Sumner's lines were worked out, they were plotted on Mercator's charts, constructed in note-books, and the intersection of the lines carried to noon.

July 12 (*Lynn Haven Bay*).—Time azimuth for compass error. Adjustments and optical principles of sextant.

July 13.—Same.

July 14, 18 (*Hampton Roads*).—General review of work gone over.

At sea, noon and latitude was reported daily to the officer of the deck by one of the cadets. Each week one cadet was detailed as assistant to navigator, and was instructed in regard to making out the usual meteorological reports, the winding and comparing of chronometers, and the other daily duties of a navigator at sea.

The interest manifested in the navigation work by the cadets has been most satisfactory.

While at anchor in the Patuxent the Dale moored ship and cleared hawse. The sheet anchor of this ship was let go, hove up, and transported to its place by means of the yards. The first-class men of both ships were present on these occasions.

It affords me much pleasure to say that the officers performed their duty with zeal and intelligence, and were untiring in their efforts in instructing the naval cadets.

I am, sir, very respectfully, your obedient servant,

N. H. FARQUHAR,
Commander, U. S. Navy,
Commanding U. S. P. S. Constellation.

Capt. F. M. RAMSAY, U. S. N.,
Superintendent United States Naval Academy, Annapolis, Md.

CRUISE OF THE DALE.

U. S. PRACTICE SHIP DALE (THIRD RATE),
Off the Naval Academy, Annapolis, Md., August 28, 1884.

SIR: I submit the following report of the summer practice cruise of this vessel, under my command: The Dale was put in commission on May 26, at Annapolis, with the following-named officers, 58 naval cadets (19 of the first class and 39 of the third class), and 98 men: Commander C. D. Sigsbee, commanding; Lieut. Albert Ross, executive officer; Lieut. F. M. Wise, navigator and instructor in navigation; Lieut. R. T. Jasper, watch officer; Lieut. Theodoric Porter, watch officer; Lieut. A. C. Dillingham, watch officer; Ensign W. F. Fullam, watch officer; Ensign S. E. Woodworth, assistant instructor in navigation; Past Assistant Surgeon D. N. Bertolette; Assistant Paymaster Eustace B. Rogers.

Ensign Woodworth was detached June 3; his place was taken by Ensign Knapp on June 10. The cadets were embarked on June 9.

Although the vessel had recently been under repairs at the Norfolk navy-yard, she was found not to have been thoroughly repaired, and I reported so to you in a letter dated June 15, 1884.

We left Annapolis inner harbor on June 16, in company with the Constellation, acting under your orders dated June 12, a copy of which is appended hereto and marked A. On our arrival at Hampton Roads, Va., on June 20, I received telegraphic orders from the Secretary of the Navy to proceed with the Dale to Norfolk. A copy of these orders is appended hereto and marked B. On June 21 the Dale was towed to the Norfolk navy-yard, where her rudder was repaired, and an inspection was made of her hull by T. D. Wilson, chief constructor of the Navy. We were towed back to Hampton Roads on June 23 by the Naval Academy tender Phlox, and found the Constellation at anchor there. Before leaving Norfolk, I received telegraphic orders from you to proceed on the cruise. A copy of these orders is appended and marked C. The Constellation put to sea from Lynnhaven Bay on June 26, but a heavy gale of wind set in soon after she had passed outside the capes of the Chesapeake, and the Dale remained at anchor near Hampton Roads. On June 30 we put to sea and cruised to the northward, for the most part between Nantucket and the northern and western limits of the Gulf Stream, as shown by the track chart accompanying this report. In the main, the weather was made very disagreeable by rain, fog, and overcast skies.

We arrived in Portsmouth lower harbor on July 16, and were towed to the navy-yard on the following day by the United States tug Leyden. On the 17th the Constellation was also towed to the yard, that vessel having arrived on that day. While at the navy-yard, the cadets performed the various duties pertaining to the routine and port drills, and visited the several departments of the yard.

The practice ships were detained at Portsmouth beyond the day originally set for sailing. This was done by order of the Secretary of the Navy, then present, in order that the officers and cadets might co-operate with the citizens of Portsmouth and with the North Atlantic fleet in the ceremonies attending the reception of Lieutenant Greely, and the Arctic fleet, under Commander Schley.

While at Portsmouth, we were fitted with a new main topmast and a new main-cap.

On July 31 Naval Cadet Burnstine, of the first class, was granted sick leave until September 29.

We put to sea from Portsmouth on August 5, one day in advance of the Constellation, and made the best of our way to the capes of the Chesa-

peake. The weather during nearly the whole passage was exceedingly disagreeable. We had heavy baffling squalls, thick weather, moderate gales of short duration, and very few observations for position. On account of heavy weather we put into Lynn Haven Roads on August 12, finding the Constellation at anchor there, she having arrived earlier on the same day.

From August 13 to August 18 the vessels were at anchor in Hampton Roads. Since then they have been working up the bay, anchoring each night in company. We arrived off the Naval Academy at 7.50 a. m. to-day.

During the cruise we have followed the excellent published routine as closely as the state of the weather has permitted, and I think the results of the cruise will be found satisfactory. Lieut. Albert Ross and the other officers of the vessel have given me hearty support and have spared no pains to make the cruise successful. A pleasanter cruise, so far as pertains to my relations with the officers, both private and official, it would be difficult to imagine. The cadets have distinguished themselves as a body by hard work and good nature, and the cadets of the first class especially, seem to have set a high standard of respectability, so far as I can judge by my own observations and the reports that have reached me. Only one cadet has made himself remarkable by defiant misconduct, and his case has been reported to you for such action as you may see fit to take.

The following is a statement, under general headings only, of the work covered in the practical instruction of cadets during the cruise.

EMPLOYMENT OF NAVAL CADETS.

First class.—Seamanship, gunnery drills, &c.—In charge of the deck, making and taking in sail, tacking, wearing, box-hauling, chapeling, missing stays, heaving to, getting casts of deep-sea lead, trawling for deep-sea specimens, shifting sails, reefing and shaking out reefs, reeving off gear, sending up and down light yards and masts, maintopmast cap and cross trees, top-mast, lower yard, and lower cap; the various evolutions in port, boat duty, as officers, and as coxswains; midshipmen of quarter-deck, and forecastle, mates of gun and berth decks, and holds and hull; aid to captain and navigator, and as petty officers, officers of gangway, divisions, &c.; gun, company, pistol, small-arm, and battalion drills, general quarters, day and night, in port and at sea; clear ship for action, target practice at sea, under way; fire quarters and abandon ship; journals and notes on visits to the different departments of the navy-yard, Portsmouth, N. H.; visits to dry-dock and monitor Passaic while in the dock and shops at Norfolk navy yard; in signals, sending and receiving messages by the Army and general service codes; anchoring and getting under way, mooring and unmooring, clearing hawse, carrying out and letting go a kedge anchor; transportation and stowing of a sheet anchor. In general, all the routine and other work pertaining to a cruise under sail, with the usual visits to port.

Third class.—Notes on all of the standing and running rigging, fore and aft, on all masts, yards, and head-booms, on all sails, ground-tackle, and fish-boom; bringing chain to capstan and bitting chain; stowage and securing of bower anchor, mooring and unmooring, and in signal code, flags, and systems; notes on Myer's signals, with much practice in signaling; exercise at evolutions of ships, at helm and aloft; special exercise on mizzen, and in loosing and furling, reefing, shaking out reefs, bending and unbending, on spare yard rigged as a topsail yard, at great guns, small-arms, pistols, company and batallion

drills, in boats, &c.; exercises in knotting and splicing, making up sails, and reeving gear, boxing the compass, marking lead and log lines, heaving lead and log, steering, &c.; all duties except cleaning ship; notes accompanied by numerous and in many cases elaborate sketches.

NAVIGATION, ETC.

First class.—Adjustment, use, and care of sextant, and practice in taking vertical and horizontal angles; use of azimuth compass in taking bearings of sun and terrestrial objects; fixing ship's position by simultaneous bearings or angles (including use of danger angle); finding distance of objects on shore by bow, beam, or quarter bearings, or successive bearings in connection with tables; notes, with sketches on aids to navigation, buoys, beacons, lights, and light-ships, and how to distinguish and use them; individual instruction and practice in pilotage from time to time as occasion offered; finding time of sunset by use of tables, and instruction in method by time sight; finding tim of high water, and which of two daily tides is higher; finding chronometer error by single altitude data given; dead-reckoning; meridian altitude of sun, and deviation of constant; latitude by Φ', Φ'' method, with form given to explain deviation of H. A., when an altitude of moon, star, or planet is observed, time-sights of sun, moon, and stars, and finding time when sun is on prime vertical; time azimuth for finding compass error. All observations out of the meridian were worked for two results to give a Sumner's line of bearing. Instruction and practice in working back from noon latitude, and forward from longitude of a. m. time-sight to find position at noon; finding noon position by the intersection of a. m. and p. m. Φ'', Φ' observations, plotted on Mercator chartlet, and worked forward and back, respectively, for run to noon; instruction in principle and practice in construction of Mercator chartlets, and plotting Sumner lines and compass bearings on them; sketch of shore from Fort Monroe to Back River light from instruction in principles of sketching given class by commanding officer; Buckner's method, construction and use of tables.

I have the honor to be, very respectfully, your obedient servant,

C. D. SIGSBEE,
Commander, Commanding.

Capt. F. M. RAMSAY, U. S. N.,
Superintendent of the Naval Academy.

A.

UNITED STATES NAVAL ACADEMY,
Annapolis, Md., June 12, 1884.

SIR: As soon as the ship under your command is ready for sea you will proceed on the summer cruise.

Circumstances permitting, I desire that you shall arrive at Portsmouth, N. H., about July 17. Sail again July 31, enter Chesapeake Bay about August 14, and arrive at Annapolis August 28.

Keep me advised of your movements when possible.

Very respectfully, your obedient servant,

F. M. RAMSAY,
Captain U. S. N., Superintendent.

Commander C. D. SIGSBEE, U. S. N.,
Commanding U. S. S. Dale, off Naval Academy.

B.

WASHINGTON, D. C., *June* 18, 1884.

Proceed with the Dale to the Norfolk yard immediately. Acknowledge receipt of this.

WM. E. CHANDLER,
Secretary.

COMMANDING OFFICER U. S. S. DALE,
Fort Monroe, Va.

C.

ANNAPOLIS, MD., *June* 23, 1884.

Proceed on cruise when you get away from navy-yard. Stop at Old Point for mail.

F. M. RAMSAY,
Superintendent.

Commander SIGSBEE,
Commanding Dale, Navy-Yard, Norfolk, Va.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, *by the United States Naval Academy.*

Detailed objects of expenditure, and explanation.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.
UNITED STATES NAVAL ACADEMY.		
FOR PAY OF PROFESSORS AND OTHERS.		
One professor of mathematics and one of chemistry, at $2,500 each (appropriated)	5,000 00	
One professor of English studies, history and law, one professor of physics, and* one of Spanish and French, at $2,200 each (appropriated)	6,600 00	
One assistant professor of English studies, history, and law, four of French, and one of drawing, at $1,800 each (appropriated)	10,800 00	
One sword-master, at $1,500 (appropriated)	1,500 00	
Two assistant sword-masters, at $1,000 each (appropriated)	2,000 00	
One boxing-master and gymnast, at $1,200 (appropriated)	1,200 00	
One assistant librarian, at $1,400 (appropriated)	1,400 00	
One secretary of the Naval Academy, at $1,800 (appropriated)	1,800 00	
Three clerks to the Superintendent, at $1,200, $1,000, and $800, respectively (appropriated)	3,000 00	
One clerk to the commandant of cadets, at $1,200 (appropriated)	1,200 00	
One clerk to pay officer, at $1,000 (appropriated)	1,000 00	
One dentist, at $1,600 (appropriated)	1,600 00	
One baker, at $600 (appropriated)	600 00	
One mechanic in department of physics and chemistry, at $730 (appropriated)	730 00	
One cook, at $325.50 (appropriated)	325 50	
One messenger to Superintendent, at $600 (appropriated)	600 00	
One armorer, at $529.50 (appropriated)	529 50	
One gunner's mate, at $469.50 (appropriated)	469 50	
One quarter-gunner, at $409.50 (appropriated)	409 50	
One coxswain, at $469.50 (appropriated)	469 50	
One seaman in department of seamanship, at $349.50 (appropriated)	349 50	
One attendant in department of astronomy and one in department of physics and chemistry, at $25 per month each (appropriated)	600 00	

* Heretofore appropriated for professor of Spanish only.

Estimates of appropriations required by the United States Naval Academy—**Continued.**

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.
FOR PAY OF PROFESSORS AND OTHERS—continued.		
Six attendants at recitation rooms, library, store, chapel, and offices, at $20 per month, each (appropriated)	1,440 00	
One band master, at $528 (appropriated)	528 00	
Twenty-one first-class musicians, at $348 each (appropriated)	7,308 00	
Seven second-class musicians at $300 each (appropriated)	2,100 00	
		53,550 00
*Additional pay to second and third clerks to Superintendent, at $200 each (submitted)	400 00	
†One messman, at $288 (submitted)	288 00	
‡Additional pay for mechanic in department of physics and chemistry, so that he may receive $3.50 per day (submitted)	365 50	
§Additional pay to six attendants at recitation rooms, library, store, chapel, and offices, at $5 per month each (submitted)	360 00	
‖One messenger to commandant of cadets, at $300 (submitted)	300 00	
		1,713 50
		55,272 50
FOR PAY OF WATCHMEN AND OTHERS.		
One captain of the watch and weigher, at $2.50 per diem (appropriated)	912 50	
Four watchmen, at $2 per day each (appropriated)	2,920 00	
One foreman of the gas and steam-heating works of the Academy, at $5 per day (appropriated)	1,825 00	
Ten attendants at gas and steam-heating works; one at $3, one at $2.50, and eight at $2 per day each (appropriated)	7,847 50	
One steam-pipe fitter, at $600 (appropriated)	600 00	
One foreman of joiners, one foreman of painters, and one foreman of masons, at $3.50 per day each (appropriated)	3,286 50	
One mason, at $3 per day (appropriated)	939 00	
Two joiners and one painter, at $2.50 per day each (appropriated)	2,347 50	
One tinner, one gas fitter, and one blacksmith, at $2.50 per day each (appropriated)	2,347 50	
		23,025 50
FOR PAY OF MECHANICS AND OTHERS.		
One mechanic at work-shop, at $2.25 per day (appropriated)	704 25	
One master laborer to keep public grounds in order, at $2.28 per day (appropriated)	832 20	
Fourteen laborers to assist in same; three at $2 per day, and eleven at $1.50 per day each (appropriated)	7,510 50	
One laborer to superintend quarters of cadets, at $2 per day (appropriated)	730 00	
Twenty servants to attend and keep in order the quarters of cadets and public buildings, at $20 per month each (appropriated)	4,800 00	
	14,576 95	
§Additional pay to twenty servants to attend and keep in order the quarters of cadets and public buildings, at $5 per month each (submitted)	1,200 00	
		15,776 95
FOR PAY OF EMPLOYÉS IN DEPARTMENT OF STEAM ENGINEERING.		
One master machinist, one boiler-maker, and one pattern-maker, at $3.50 per day each (appropriated)	3,286 50	
Two machinists and one blacksmith, at $2.50 per day each (appropriated)	2,347 50	
Four laborers, at $1.50 per day each (appropriated)	2,034 00	
	7,668 00	
¶One molder, at $2.50 per day (submitted)	782 50	
		8,450 50

* The duties performed by the second and third clerks to the Superintendent are fully worth the additional compensation submitted.

† A messman has been allowed for twenty-eight years; it was omitted from the appropriation for the fiscal year ending June 30, 1883, through a misunderstanding.

‡ This position requires a skilled mechanic and instrument maker.

§ These men are obliged to clothe, board, and lodge themselves, and cannot do so on less than $25 per month.

‖ A messenger is a necessity to the officer filling the position of commandant of cadets.

¶ A molder has been allowed for sixteen years, except the past two years. The services of a molder are necessary.

Estimates of appropriations required by the United States Naval Academy—Continued.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.
REPAIRS AND IMPROVEMENTS.		
For necessary repairs of public buildings, pavements, wharves, and walls inclosing the grounds of the Naval Academy, and for improvements, repairs, and furniture and fixtures (appropriated)	....	$21,000 00
FUEL FOR HEATING AND LIGHTING.		
For fuel for heating and lighting the Academy and school ships (appropriated)	....	17,000 00
CONTINGENT EXPENSES.		
For contingent expenses, Naval Academy:		
For purchase of books for the library (appropriated)	....	2,000 00
For stationery, blank books, models, maps, and text books, for use of instructors (appropriated)	....	2,000 00
For expenses of Board of Visitors to Naval Academy (appropriated)	....	1,500 00
*Additional for expenses of Board of Visitors (submitted)	....	1,100 00
For purchase of chemicals, apparatus, and instruments in departments of physics and chemistry, and for repairs of same (appropriated)	....	2,500 00
For purchase of gas and steam machinery, steam pipe and fittings, rent, of buildings for the use of the Academy, freight, cartage, water, music, musical and astronomical instruments, uniforms for the bandsmen, telegraphing, and for feed and maintenance of teams, and for the current expenses and repairs of all kinds, and for incidental labor and expenses not applicable to any other appropriation (appropriated)	....	34,600 00
For stores in the department of steam engineering (appropriated)	....	800 00
For materials for repairs in steam machinery (appropriated)	....	1,000 00

* The average yearly expenses of the Board of Visitors for eight years was $2,520.89. The traveling expenses alone for ten members of the Board of Visitors for the year 1883 was $1,317.84. Two members of the Board were not present and drew no travel.

RECAPITULATION.

Pay of professors and others	$55,272 50
Pay of watchmen and others	23,025 50
Pay of mechanics and others	15,776 95
Pay of employés in department of steam engineering	8,450 50
Repairs and improvements	21,000 00
Fuel for heating and lighting	17,000 00
Contingent expenses	45,500 00
Total amount estimated for	186,025 45

Respectfully submitted.

F. M. RAMSAY,
Captain U. S. Navy, Superintendent.

UNITED STATES NAVAL ACADEMY,
Annapolis, Md., September 17, 1884.

Hon. W. E. CHANDLER,
Secretary of the Navy.

No. 4.—BUREAU OF YARDS AND DOCKS.

BUREAU OF YARDS AND DOCKS,
NAVY DEPARTMENT,
Washington, D. C., November 8, 1884.

SIR: The following report of the operations of this Bureau for the fiscal year ending June 30, 1884, is respectfully presented, accompanied by (and forming a part of said report) tabulated statements of the expenditures and estimates from the commandants for the fiscal year ending June 30, 1886.

From these statements it will be seen that the gross amounts estimated are as follows:

For works of improvements	$7,754,721 37
For repairs and preservation	1,159,836 69
For general maintenance	566,841 53
For civil establishment	49,264 25
Grand total	9,530,663 84

Sheets Nos. 7 and 8 present in detail the objects for which the estimates are made under the two principal heads of "general maintenance" and "repairs and preservation," while sheet No. 6 presents in detail the objects of "improvements" as estimated for.

Considering the very limited appropriations under which the navy-yards have been operated for the past few years, I am of opinion that the estimates under the two heads "general maintenance," and "repairs and preservation," are not much, if any, in excess of the actual requirements to maintain the ordinary requirements of the yards, and to make good the deterioration of enforced neglect.

Under the heads of the various yards, I shall respectfully present my views on such of the estimates as seem to me deserving of special mention. I deem it only proper to say here that in my opinion the limited appropriations of the last few years have been devoted to such work as presented the most immediate and pressing necessity, but of necessity leaving much undone that should have been done, and I would further say that, in all important matters looking to the economical administration of the affairs of the Bureau, it has almost without an exception been cheerfully assisted by the commandants of the various yards.

NAVY-YARD, PORTSMOUTH, N. H.

Among the items for "repairs and preservation" at this navy-yard will be found one of $20,000 for dry-dock. This sum will be absolutely required to put the floating dry-dock and ways in thoroughly serviceable condition, and I deem it of so much importance that I would recommend this amount to be taken from the general appropriation of "repairs and preservation," and made a special one, under the head of "improvements," to be made available as soon as passed, in order that

the work of repairs to this important and valuable adjunct may be commenced before deterioration progresses further.

Under the head of "improvements" at this yard is an item of $25,000 for "water-works." The many steam generators furnishing power to the various mechanical industries of this yard are mainly dependent for their supply of water upon two ponds, of limited area, upon Seavey's Island. These ponds are supplied partially from springs, but mainly from rains. The *superficial* area of the largest and the principal of these two ponds has been so extended by alluvial deposits, and by the rank growth of weeds and grasses, as to very seriously reduce its storage capacity, while at the same time very largely increasing its evaporating surface. It should be dredged, and its confining embankment be raised. The supply of water is now barely sufficient for the limited operations of the yard, and should an emergency arise requiring the operation of the entire steam-power of the yard, water would have to be brought in tanks or casks from some miles up the Piscataqua River, at a very heavy cost in time, labor, and money, and with very doubtful results.

NAVY-YARD, BOSTON, MASS.

During a portion of the fiscal year embraced in this report the operations of this yard have been carried on under an appropriation for "closed navy-yards," but the portion of this appropriation which could be allotted to it being inadequate, it has been helped out from other appropriations.

The anomalous position of this navy yard places me under some embarrassment as to what to recommend; but assuming that it is not to be abandoned, but, on the contrary, to be eventually restored to its former condition of efficiency, and indeed to a point beyond, commensurate with the needs and requirements of the new Navy which it is to be hoped the liberality of Congress may soon create, I respectfully recommend specially the following items under appropriation "repairs and preservation," yard buildings, wharves, bridges, &c., roads, walks, gutters, &c., cranes, scows, and derricks, dry-dock, as being of primary importance.

Of the works estimated for under the head of "improvements," all are of such primary importance to the efficiency of a first-class yard that I only hesitate in recommending all, because of the amount involved.

Of these "improvements," the most important seems to me to be the "iron-platers' shop" "relaying of water-pipes"—the bad condition of the present underground service involving great waste—"cart shed"—necessary for the proper care and preservation of yard vehicles—"floating gate to dry-dock," and the "rebuilding of wharves."

Repairs to the dry-dock are provided for under the appropriation "repairs and preservation," but the new gate is asked for under the head of "improvements."

This dock has a pair of swinging gates, and a caisson. The former have not been used for many years, owing to their decayed and unsafe condition. The caisson is also in bad condition, and it will soon become necessary to put it out of service, which will render the dock useless. One gate is not enough for the dock, and I strongly urge an appropriation for a "new caisson," or a pair of turning gates, preferably the former, as more convenient in use, and less liable to disarrangement. With two caissons the danger of accident is lessened.

The rebuilding of the wharves I deem of great importance. The wharf facilities are inefficient for a first-class yard in active operation,

and what we now have are in a dangerous condition; on some of tl a horse and cart cannot be trusted.

With the prospective increase, or more properly the building, of a new Navy, the docking facilities of this yard will be found inad‹

The substitution of a modern derrick in place of the present ant ıa and inadequate sheers for lifting heavy weights, is a matter that wıı require serious consideration in connection with the rebuilding of· Navy. The capacity of the present sheers is believed to be not exceeı· ing 70 tons.

There are modern guns far exceeding this weight.

The estimates from the navy-yard, Boston, for two additional dry-do are $2,455,200. No estimate is presented for a new derrick, but it woı probably cost from $50,000 to $60,000. These two items are present‹ not as objects of immediate necessity, but as contingent upon the future action of Congress in the retention of the yard and rebuilding of Navy.

NAVAL STATION, NEW LONDON, CONN.

No work has been done at this station during the fiscal year, and no expenditures made, except such as have been necessary to the care of the public property and maintaining communication between the station and city of New London, from which place all supplies are drawn. The total of expenditures for these purposes has been $4,042.55, and for the fiscal year ending June 30, 1886, it is estimated that there will be required a total of $6,850, viz: $1,200 under "repairs and preservation" and $5,650 under "general maintenance." This increased amount is asked for that proper care may be taken of the public property pertaining to the station.

I respectfully renew my recommendation of last year, that if nothing is to be done in the way of developing the possibilities of this station all the portable property be transferred to some other yard, or sold, and the station left in charge of one or two reliable watchmen, one of whom shall at all times be present.

NAVY-YARD, NEW YORK.

The works of improvement at this yard were the intercepting sewer, dredging, and rebuilding of dry-dock caisson, for which there was an appropriation of $150,000.

"The new sewer as completed is a great improvement. The filthy sewage of a large city area, heretofore discharged into the sluggish waters of the Wallabout in the immediate neighborhood of the working part of the yard, is now carried to the East River, where it is quickly so diluted as to be inoffensive, and where the swift tidal currents will, it is believed, prevent any great accumulation of deposit. A marked and most favorable change in the character of the water along the wharf front immediately followed the completion of this new sewer."

From the water-front of this yard there has been removed by dredging 205,809 cubic yards of material, at a cost of 24⅜ cents per cubic yard, as per contract.

The dry-dock caisson has been practically rebuilt, at a cost of $20,814.72.

Of the appropriation of $50,000 made for the improvement of the cob dock, the small sum of $2,636.63 has been expended for pay of draughtsman in making plans and for materials and labor in repairing the bridge leading from the yard to the cob dock. Under your instructions no

other expenditure from this fund was to be made except in the direction of a comprehensive plan for the general improvement of the cob dock. Such a plan was made, and received the approval of the Bureau and yourself.

This plan embraced as a primary feature the construction of a solid bridge or causeway between the yard and the cob dock.

The question of our right to erect a permanent structure which would interfere with the water travel through the Wallabout channel having come up, it was decided to do nothing until this point was settled. It not having been settled at the end of the fiscal year ending June 30, 1884, the balance of the appropriation, viz, $47,363.37, reverted to the Treasury, but Congress at its last session reappropriated this amount, and it is now to our credit for this fiscal year.

Repairs more or less extensive have been put upon thirty-eight of the buildings in the yard, as also upon the wharves, roads, drains, fences, &c. The funds available for this description of work have been so inadequate, much of it has necessarily been very slight and superficial. There is much to be done in the way of repairs.

Estimates are presented for the following works of improvement: General storage for yards and docks, $85,000; boiler-shop wing to machine-shop, $123,935; shipwrights' shed, $14,000; dry-dock caisson, $30,000; repairs to dry-dock, $125,000; two timber dry-docks, $1,200,000.

The great need of a building for storage purposes is self-evident, when materials, tools, and appliances of every kind are found stored about in odds and ends of places, many exposed to the vicissitudes of weather, and all more or less exposed to injury and depredation.

The boiler-shop wing to the machine shop is simply the carrying out of the original plan of this building, and is deemed necessary for the efficient operations of the department of steam engineering.

The shipwrights' shed is needed for facilitating the work in construction department, especially that upon vessels undergoing repairs in the dry-dock. The present structure is past repair, is useless—in fact, an element of danger.

An additional caisson is estimated for. I deem this essential. The iron turning gates are no longer safe or fit for use, the sheathing having entirely corroded through in many places, and the ribs being very much reduced in strength by corrosion. When the dock is thoroughly repaired, as it soon must be, either a new pair of turning gates or an additional caisson must be supplied. For many reasons the caisson is preferable.

An estimate is presented and urged for an appropriation of $125,000 for repairs to the dry-dock. This dock is in such condition that it has been pronounced by a board of experts as unsafe.

Such temporary expedients as could be devised, almost wholly of wood, are now in use to render it safe, but it should be taken in hand and thoroughly repaired as soon as the money can be available.

This dry-dock is of the first importance to the Navy. Of the three stone docks belonging to the Government, it is the only one having sufficient length to dock the Tennessee. In this connection is it not advisable to provide for at least one more dry-dock at this navy-yard?

An estimate is presented for *two* timber dry-docks, on the Simpson plan, at a cost of $1,200,000 for the two.

The estimated cost of a granite dock of 500 feet in length is $2,000,000 (the present one of 350 cost more than that), while that of *two* Simpson docks of the same capacity is $800,000 less.

The extensive use of iron and steel in the modern construction of ships render more frequent docking necessary than is the case with wooden ships, and hence the necessity for more docks.

I deem it of great importance that the proposed work of improvement of the cob-dock property should be carried on, and an appropriation of $200,000 it is thought can be judiciously and economically expended on it during the coming fiscal year.

Under the heads of "repairs and preservation" and "general maintenance," the estimates are respectively $242,000 and $128,000. These amounts seem large, but I am not prepared to say they are excessive; on the contrary, they will not more than suffice to repair damages of the past, and partially keep up with the decay of the future. Every dollar of it can be properly and profitably expended in caring for the public property.

NAVY-YARD, LEAGUE ISLAND, PA.

This navy-yard has been to all intents closed, so far as the operations of this Bureau are concerned, for the greater part of the present fiscal year, and yet the expenditures under the heads of "repairs and preservation" and "general maintenance" have been $20,947. The uncertainty of the future status of this yard causes great embarrassment in estimating for the coming fiscal year.

For erecting the buildings and making the improvements originally (and subsequently from year to year) contemplated involves a sum in close proximity to $1,000,000, or rather, that is the estimate.

Under the present circumstances I only propose to ask for an appropriation of $26,416.40 for the construction of a wharf at the foot of Fifteenth street, under the head of improvements, this seeming to be an item of importance.

Under the head of "repairs and preservation," I have asked for $67,000, and under "general maintenance," $50,000, and these sums are not more than will be sufficient to care for the property even when no work is going on in the many buildings, and no wear and tear of roads, walks, wharves, bridges, &c. Should the yard be reopened for work, a larger amount will be necessary.

NAVY-YARD, WASHINGTON, D. C.

The only work of improvement carried on at this yard during the fiscal year has been that of dredging the channel. The total amount expended to June 1, 1884, has been $15,715.65, and the material excavated and deposited on the flats has been 105,338 cubic yards, or at the rate of 14.9 cents per cubic yard; adding 20 per cent. of the cost of the scows, the total cost of dredging will be 16.34 cents, a showing very creditable to the engineer under whose immediate supervision the work has been done. The result of the dredging operations has been the securing of a channel from the navy-yard to the Arsenal Point of eighteen feet depth at low water, and a mean width of 125 feet, while in front of the yard the same depth has been secured with a width at the bottom varying from 220 to 270 feet; but it is estimated that this is still insufficient for the needs of the yard, and it is recommended that the work be continued until widths of 200 and 350 feet be obtained in the respective channels; for while it may be argued that the present width and depth may be sufficient for present needs, but in view of the prospective business of the yard, and the liability—owing to the nature of the

bottom through which the cuttings are made—of caving or sliding, thus reducing the width, it is very desirable that the work should be continued, and for this purpose an estimate of $25,000 is suggested.

The total expenditure for material and labor, under appropriation "repairs and preservation," has been $17,274.80, a sum inadequate for the proper care of the very large amount of property to be cared for under that appropriation.

Under appropriation "general maintenance" the total expenditures for material and labor have been $23,193.24, and the same remarks may be applied to this as to those under "repairs and preservation."

Every effort has been made, not only at this but in all the other yards, to keep the expenditures within the limit of the appropriations. This has been accomplished, but I am satisfied that it has not been in the interests of practical economy.

The estimates presented for works of "improvement" are for new ordnance machine-shop, $95,000. This is in accordance with the recommendation of a board of officers appointed by the honorable Secretary of the Navy, approved June 30, 1881; the extension of yard wall through marsh on south side, $21,711. This is necessary for the protection of the yard, which is entirely open on that side, and the appropriations do not furnish sufficient funds to provide an adequate police force. Continuation of dredging, $25,000. Construction of ventilating flue for smithery, $12,250. An estimate has been made yearly for the last three years for the increase of the yard by the purchase of two additional city squares, at a cost of $25,000, but as the present business of the yard is principally manufactures, prosecuted in buildings already erected and believed to be ample, this addition is not now recommended.

The condition of the west ship-house is such as demands immediate attention. It should be extensively repaired or else demolished. In the former case a special appropriation would be required, but as shipbuilding has practically ceased at this yard, I would not advocate the repairing of this building, but rather its demolition.

The estimates for "repairs and preservation" are $30,000, and for "general maintenance" are $40,000.

NAVY-YARD, NORFOLK, VA.

No works of improvement have been undertaken at this yard.

The expenditures under the appropriation "repairs and preservation" have been $38,606.44, and under "general maintenance" $31,089.34. While much has necessarily been left undone, it is gratifying that so much has been accomplished.

The estimates presented from this yard for recommended improvements therein amount to over $1,000,000.

The importance of this yard seems to warrant the expenditure of large amounts to improve its capacity for any and all kinds of work which it may be called upon for. The natural advantages of this navy-yard in location and climate specially recommend it for consideration. From among the many objects of improvement presented in the annual report forwarded by the commandant the following are selected as being most important: Dry-dock extension, $240,062; new pumps for dry-dock, $52,600; extension of quay-wall, $384,400; railroad extension, $47,479; floating derrick, $49,189.

The existing stone dry-dock, a good and substantial structure, is in good condition, but is not adequate for the coming needs of the service. The ships now building and those contemplated to be built in the future

are too long to be docked here. There being no other Government dock nearer than New York, the importance of this one at Norfolk is manifest, and its capacity to do any work that may be assigned to it should be placed beyond peradventure. I therefore strongly recommend the appropriation asked for. In this connection it is safe to say that one dry-dock is insufficient in so important a yard. There should be at least two of these important adjuncts. A second dock could be advantageously built in close proximity to the existing one, and the new pumps and pumping machinery asked for could be so placed as to do the work of both docks. In case you concur with me in opinion as to the necessity of another dry-dock, I shall be glad to present plans and estimates for the same. If the existing dock is enlarged as recommended, I deem it essential that new pumps, &c., be provided. The capacity of the present pumps, of old style and inferior power, is barely sufficient for the dock in its present condition.

The extension of the quay-wall is a work of great importance, and should be carried forward with as little delay as possible. In consequence of the ravages of the teredo, wooden structures in the waters in and about Norfolk are of limited duration—not more than six or seven years. The amount annually expended in keeping the present wooden wharves in serviceable condition is fully as much if not more than the interest at six per cent. on the amount asked for the continuation of the quay-wall.

The estimate for the extension of railroads is believed to be in the interest of economy. It contemplates substituting steam for oxen, horses, and mules, and it is believed that a greater amount of work, and at considerably less expense, can be secured than by the present slow system.

A floating steam-derrick is an important and necessary appendage to a navy-yard, especially one like this, with an extended water-front. At this time there are no means of transporting heavy masses from one part of the yard to another, and it may often become important to remove from or put into a ship boilers or heavy guns when the standing derrick cannot be spared for the purpose.

Estimates for "repairs and preservation" at this yard are $100,000, and for "general maintenance" $56,000."

NAVY-YARD PENSACOLA, FLA.

The total expenditures at this yard during the fiscal year have been $19,084.81 under all heads of appropriation.

The yard has been closed for all general work, and only such expenses have been incurred as were absolutely necessary for the care of the public property.

The climatic influences at this station are such as to cause more rapid deterioration and to require more constant attention to out-door property than is the case at more northern stations. Among other items of property thus situated are four sections of an iron floating dry-dock. The machinery for this dock is stored under cover in the yard, but the dock itself is exposed to the elements. Two of these sections are now hauled up on the beach, after serious injury by being sunk in the basin. The two sections still afloat are undergoing the same process of injury by corrosion in salt water, and there are no funds at the disposal of the Bureau with which to properly care for them. These two sections should be hauled out and properly cared for, and to do this I estimate will require about $10,000. But if the navy-yard is not to be maintained, it would be economy to sell this dock.

The estimates presented for the care of this yard and property for the next fiscal year are $6,850.90 for "repairs and preservation" and $12,630.50 for "general maintenance."

NAVAL STATION, KEY WEST, FLA.

The expenditures at this station have been $7,819.02, of which amount $4,354.08 was in connection with the new wharf, leaving the amount actually expended on the station proper $3,464.94.

The estimates for the coming fiscal year for "general maintenance" are $1,789.50 and for "repairs and preservation" $6,355.70, and a special estimate of $15,000 for the purchase of the Mallory lot. This so-called Mallory lot is a piece of property interjected into the Government possessions, dividing them, and preventing access from one part to the other without going around by the street. Its possession by private parties is also an injury to us in the curtailment of water-front.

The estimate for "repairs and preservation" is intended to cover not only the ordinary repairs and care of buildings, fences, walks, &c., which in this climate need more than ordinary care, but to rebuild the bulkhead around coal-house, to build a cistern at the machine-shop, to relay a portion of the railroad track, and to furnish suitable coal-cars.

The entire water-front of our property should be bounded by a permanent concrete wall, to preserve it from the encroachments of the sea.

The cistern at the machine-shop is of first importance. Its present supply is rain catchment in two old iron ship-tanks, of capacity to supply the boiler for a few hours only. When the machine-shop is in active operation its supply of water has to be carted from the main storehouse cisterns a considerable distance and at considerable expense.

NAVY-YARD, MARE ISLAND, CAL.

Progress upon the stone dock in process of construction at this yard has been very satisfactory. The entrance of the dock has been completed, and were the pumps in place, the dock could be used in a few months, though not entirely completed as designed.

The completion of the entrance and the near completion of the caisson has largely eliminated the element of danger from the weakness and dilapidated condition of the old coffer-dam.

A contract was made with the Union Iron Works of San Francisco on the 5th of March, 1884, for the construction of a caisson. This caisson is at present writing very near completion, but it is not proposed to put it in its place until the erection of the pumping machinery, a contract for which was made with the Southwark Foundry and Machine Company of Philadelphia on the 31st of July, 1884. I had hoped that this important work would have been completed during my term of duty as chief of this Bureau, but that is out of the question, and as this will be my last official utterance on this subject, I desire to place upon record my high appreciation of the industry, skill, zeal, and intelligence with which the work has been carried on by those immediately concerned in it. I am more than satisfied with the wisdom of the selection of the civil engineer, Mr. C. C. Wolcott, under whose personal supervision and control the work has progressed for the past two years and more.

In presenting the estimates for improvements at this yard for the next fiscal year, I would premise by saying that while they seem large, when the importance of this yard is considered, at present, and what

its importance will be in the future, when the Navy shall be restored, even in part, to its former magnitude, the estimates will not seem so extravagant.

Completion of stone dock	$360
Extension of timber-shed No. 94	13
Cisterns	46,
Rolling-mill for steam engineering	40,
Boiler-shop floor	4,
Wharves	93,000
Roads	42,517
Sewers	7,000
Gate-house and guard-house	20,000
Artesian well	10,000
Iron crane	40,000
Iron-plating shop	4,000

It is confidently believed that the amount asked for to complete the dry-dock will be ample for that purpose. It is not alone the completion of the dock in itself that is contemplated, but the completion of the surroundings.

In 1873 a plan of this yard was formulated by a Board of Civil Engineers, and was approved by the Secretary of the Navy. One of the features of this plan was the reduction of the grade of the yard twenty-two inches along the present water front. The coping of the dock was made to conform to this grade, and as the recommendations of the Board have never been carried out, the result is that the coping is from 4 to 9 feet below the present grade, making of the dock a reservoir for the drainage of the contiguous territory.

The second item, viz, "Extension of timber-shed No. 94," has been urged annually since I have been in this office. Its necessity is as apparent as it was originally.

Of the third item of the estimates, viz, "Cisterns," I can only repeat what I said in my last annual report. The water famine of the last two years has shown the necessity of greater storage capacity. Since the enlargement of the reservoir the rainfall has been so slight as to make no appreciable increase to its contents. Our supply of water is mainly derived from the Vallejo water-works, and during the past season their source of supply has run so low that they have been obliged to curtail the quantity, and at times to cut off entirely the allowance to the yard, compelling a reliance upon our very limited cistern storage and the little brought from time to time by boat. It is needless to say that a large establishment of this kind, with so much valuable property at stake, should not be left in this condition. A water famine such as has existed at this yard during the last year and part of the preceding, is an ominous warning of the impolicy of relying entirely upon catchment for our supply of water. At the urgent solicitation of the civil engineer, Mr. Wolcott, favorably indorsed by the commandant, I consented to a trial to procure water by boring. I confess to some hesitation in giving consent to the proposal, from the fact that repeated experiments in this direction previously made had failed. Nevertheless, the arguments in favor of success, and the importance of the result, if successful, overcame my hesitation, and consent was given. Operations were commenced on December 31, 1883, and prosecuted with imperfect appliances and with such limited funds as I could spare from time to time until July 1, 1884, when a depth of 500 feet had been reached and a flow of water of about 10,000 gallons per day secured. The indications are of the most favorable character for ultimate success in securing an abundant supply of water. The cost has been

thus far $3,500. The last 400 feet of progress have been through marked water-bearing strata, very similar in character to that through which a well was successfully driven at Benicia, some 20 miles distant. The Benicia well reached a depth of 1,650 feet, at a cost of $25,000. A similar well at Charleston, S. C., has a depth of 1,260 feet, at a cost of $30,000. I earnestly urge the appropriation asked for the continuation of our well. The cost thus far has been insignificant in comparison with the two cited, and it is not probable that its future cost will very much exceed the cost per foot of that already accomplished. But even should it do so, the immense value of an abundant, never-failing supply of water would amply compensate for the money bestowed.

A rolling-mill should be an essential feature of every navy-yard. Without one the valuable scrap-iron which accumulates in a navy-yard has to be sold, and rarely brings anything like its value, but when re-rolled, at comparatively small cost, becomes a very superior article. The rolls and machinery for working up this now useless scrap are on hand in the yard. The appropriation is asked to erect a suitable building and construct the foundations for the heavy tools and machinery.

Of the 1,800 feet water front of this yard, but 1,000 feet is adequately protected by a permanent quay wall. The remaining 800 feet is an unsubstantial wooden structure. The appropriation is asked for to complete this portion of 800 feet in conformity with that already completed, and to extend the line of piling to the machine-shop. Until the entire front of the yard is protected by a smooth, straight surface, directing the flow of the stream, extensive deposits will be made in the irregularities of the shore-line, rendering constant dredging necessary.

The importance of good roads in a navy-yard is manifest. To any one acquainted with the location of Mare Island navy-yard, the impossibility of having good roads without paving or macadamizing is equally manifest. It is proposed to macadamize 5,140 feet in length, by an average width of 64 feet, of some of the principal and most used streets. In the rainy season the condition of these roads is simply abominable.

The sewers of this yard do not seem to have been constructed on any comprehensive system, but rather as necessity has arisen from time to time, or means were available. In one instance there is a sudden rise in grade of four inches, causing a damming back for more than two hundred feet. The entire sewerage system needs revision, if not rebuilding; at present they are a danger.

The crane or Bishop's derrick at this yard is in such a condition of decrepitude as to be unsafe for a lift of over twenty tons, and being a wooden structure, it would not, in my opinion, be good economy to repair it. The Board of Survey which reported upon this derrick in January, 1884, recommended that an iron crane, to be worked either by steam or hydraulic power, and of a capacity of one hundred tons, be erected on the site of the present disabled one. The necessity for this important tool cannot be overestimated. It is believed that at the present time there is neither crane nor derrick on the whole Pacific coast which will hoist a weight of twenty tons. An appropriation of $40,000 is asked for to meet this pressing want.

NAVAL ASYLUM, PHILADELPHIA.

There were on the rolls July 1, 1883, the names of one hundred and eighty-nine beneficiaries. During the fiscal year ending June 30, 1884, thirty have been admitted, sixteen have died, three have been dropped for absence without leave, one has been discharged at his

own request, and one has been dismissed for misconduct, and two have been transferred to the Government Hospital for the Insane, leaving on the rolls July 1, 1884, the names of one hundred and ninety-six beneficiaries, an increase of seven.

The expenditures for the past fiscal year were $57,817.80, and the estimates for that ending July 30, 1886, for care of buildings and grounds, support of beneficiaries, repairs, furniture, &c., 76,111. An additional estimate of $22,000 is submitted for an addition to the main building.

The estimates for the ordinary expenses of the institution are very considerably increased in the estimates over the last year, in consequence of the increase in the number of beneficiaries, and to provide for an addition of one corporal to the house police force, for an increase of pay to the matron, steward, master-at-arms, house corporal, and also an increase of pocket money to beneficiaries, from $1 to $2 per month, and for an increase of three waiters. With the continual increase of inmates the work naturally increases in all departments of the institution, and the increased compensation asked for is not unreasonable.

The increase of three waitresses I deem absolutely essential. To wait upon nearly two hundred persons at table, many of whom are as helpless as children, is beyond the capacity of five women.

An increase is also estimated for under the head of "repairs."

If the verandas are not soon extensively repaired they will require to be rebuilt.

The walls of the main building are sadly in need of repairs.

I again respectfully call attention to the importance, if not necessity, of an addition to the Asylum building. I have on two former occasions endeavored to represent the importance of this addition. Its necessity is more apparent now. At this writing, every room available for the accommodation of the beneficiaries is occupied, and orders have recently been given to convert one of the reading-rooms into a dormitory. However inconvenient this may be to the present occupants, it is necessary, for it would be bad faith to the old veterans, who by long and faithful service have earned a right to a home here, to turn them from the door, disappointed, poverty-stricken, and friendless. I cannot better represent the necessity for this addition than by quoting from the annual report of Commodore Roe, the governor of the institution. He says:

> There is no provision made here for beneficiaries or employés to wash their persons properly, and not a convenience for bathing in the house. This matter has caused manifold complaints, and the complaints are just. The cooks and waitresses, in the kitchen, working all day in a fierce heat, have no place in which to bathe or keep themselves properly clean. The female attendants occupy a corridor in which the men have their rooms, separated only by a wicker door, or gate, from the men. This is manifestly bad, and for the sake of decency should be remedied. The remedy for this catalogue of evils is only to be found in the erection of a new kitchen in the rear of the house and connected with it by a covered way. This building should include, besides a kitchen, wash-room, ironing-room, bath-room, and water-closets for the female attendants, on the lower floor, dormitories for the women, and a sewing-room for the matron. This will enable the mess-hall to be extended by removing the partition be tween it and the ironing-room, and the present wash-room may, with its heating fil tures, give a good bath-room for the beneficiaries, and the present kitchen be turned into store-rooms. The removal of the female attendants from the men's corridor will give additional room for the beneficiaries, for whose accommodation there is a constantly growing pressure.

In the matter of pensions, the law provides that in the case of a pensioner receiving the benefit of a "Soldiers' Home," he shall not forfeit his pension. In the Naval Asylum the pensioner forfeits his pension the moment he becomes an inmate, and for the time he remains an in-

mate; the forfeited pension being turned over to the hospital fund. This is an invidious distinction which, I think, should be abolished. If these old men are deprived of their pensions on entering the institution, it can only be for the reason that the pension fund is supporting them in a different way. Why, then, should these forfeited pensions go to swell the hospital fund (except that it is the law)? Why should they not revert to the pension fund, where it would seem they more properly belong, especially as this pension fund is built up on the war services rendered by the pensioners themselves?

CONTINGENT.

The sum required under this head, viz, $25,000, is to meet unforeseen emergencies that may arise, calling for immediate outlay that has not been estimated for. It is a small but most necessary reserve.

Accompanying this report is an abstract of offers for supplies received for furnishing articles coming under the cognizance of the Bureau of Yards and Docks, made in conformity to act of Congress approved March 3, 1843.

The following estimates for the fiscal year ending June 30, 1886, are respectfully submitted, viz:

For support of Bureau of Yards and Docks	$13,810 00
For general maintenance of yards and stations and contingent	450,289 00
For support of Naval Asylum	98,111 00
For repairs and preservation	838,200 00
For improvements at navy-yards	3,799,865 29
For civil establishment	45,929 75
Total estimate of yards and docks	5,246,205 04

Very respectfully, your obedient servant,

EDWARD T. NICHOLS,
Chief of Bureau,

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy, Washington, D C.

No. 1.—*Report of expenditures at navy-yards, stations, and Naval Asylum for the year ending June 30, 1884.*

APPROPRIATIONS.

Yards and stations.	Yard improvements.	Repairs and preservation.	General maintenance.	Closed navy-yards.	Civil establishment.	Contingent.	Total.
Portsmouth, N. H		$20,567 31	$27,240 84		$2,933 88		$50,742 03
Boston, Mass		12,990 09	16,854 50	$21,830 59	2,699 97	$3,573 20	57,948 35
New London, Conn		32 00	1,347 00	2,695 20		168 35	4,242 55
New York, N. Y	$52,612 63	34,435 93	50,345 67		4,734 49	2,020 00	144,148 72
League Island, Pa			7,732 77	13,215 61	2,695 14	2,000 00	25,643 52
Washington, D. C	15,715 65	17,274 80	23,193 24		2,700 00	920 76	59,804 45
Norfolk, Va		38,606 44	31,089 34		3,483 22	6,772 88	79,951 88
Pensacola, Fla		1,313 17	5,109 94	11,689 18	972 52		19,084 81
Mare Island, Cal	250,329 83	27,664 57	36,309 64		3,668 62	3,500 00	321,472 66
Sackett's Harbor, N. Y			645 00			48 00	693 00
Key West, Fla	3,810 00	2,501 27	1,507 75				7,819 02
Naval Asylum, Pa	57,817 80						57,817 80
Wharf at Erie, Pa						500 00	500 00
Total	380,285 91	155,385 58	201,375 69	49,430 58	23,887 84	19,503 19	829,868 79

No. 2.—*Detailed report from navy-yards and stations of expenditures under "repairs and preservation" during the fiscal year ending June* 30, 1884.

Objects.	Portsmouth.	Boston.	New London.	New York.	Washington.	Norfolk.	Pensacola.	Mare Island.	Key West.	Total.
Yard buildings	$4,237 07	$135 50	....	$9,075 03	$7,335 24	$4,810 67	$71 19	$6,343 65	....	$32,008 35
Officers' quarters	2,433 87	16 85	....	8,162 23	1,772 12	816 35	245 12	1,952 94	....	15,399 48
Wharves, bridges, landings, and boats	516 62	84 57	....	5,114 32	109 01	5,611 89	4 38	5,932 61	$1,544 08	18,917 48
Roads, walks, gutters, and drains	2,866 11	75 57	....	3,100 75	4,049 72	11,501 96	11 43	4,189 63	....	25,795 17
Fences and walls	296 77	....	....	910 71	879 31	358 84	3 12	1,769 14	110 00	4,327 89
Cranes, scows, and derricks	185 30	....	....	1,111 12	41 30	533 29	6 10	1,881 43	....	3,758 54
Furnaces, forges, heating apparatus, &c	1,419 17	383 92	$32 00	2,481 47	82 30	544 70	....	240 74	....	5,184 30
Tracks and scales	109 82	....	....	73 12	655 33	68 36	....	164 00	....	1,070 63
Water and gas works	2,196 47	322 02	....	1,754 21	1,348 91	1,529 92	33 89	3,357 32	....	10,542 74
Dredging and scowing	....	....	....	....	50 55	3,227 77	....	....	....	3,278 32
Dry-docks	620 92	....	....	1,622 03	....	1,272 64	28 59	1,833 11	....	5,377 29
Miscellaneous repairs	5,685 19	11,971 66	....	1,030 94	423 00	8,330 05	909 35	....	847 19	29,197 38
Manufacturing iron for Norfolk yard	....	....	....	....	528 01	....	....	....	....	528 01
Total	20,567 31	12,990 09	32 00	34,435 93	17,274 80	38,606 44	1,313 17	27,664 57	2,501 27	155,385 58

No. 3.—*Detailed report of expenditures under "general maintenance" received from yards and stations during the fiscal year ending June 30, 1884.*

Objects.	Ports-mouth.	Boston.	New London.	New York.	League Island.	Washington.	Norfolk.	Pensacola.	Mare Island.	Key West.	Sackett's Harbor.	Total.
Freight and transportation		$175 00		$814 16	$18 00	$10 78	$2 90		$3,287 65			$4,308 49
Printing, stationery, and advertising	$350 04	285 65	$47 30	478 20	344 14	323 26	361 09		1,215 60	$27 50		3,432 78
Books, maps, models, and drawings		12 00				46 13	145 25		18 15			221 53
Purchase and repairs of fire-engines	50 34			452 87			34 23	$582 59	1,440 00			2,560 03
Machinery of every description and patent rights		2 00			134 95	168 05	313 55	5 39	282 18			906 12
Repairs on steam-engines and attendance on same				868 94	16 37		4,916 29	220 12	698 84			6,720 56
Purchase and maintenance of oxen and horses, pay of hired teams, &c	3,402 99	2,245 08	216 70	7,362 77	1,528 31	3,019 73	4,130 58	1,058 63	6,221 96			29,186 75
Carts, timber-wheels, and tools of every description	346 99	99 09		1,129 62	254 86	781 73	658 21	92 98	156 61	17 00		3,537 09
Postage on letters on public service and telegrams	124 88	20 00	1 50	272 60	49 79	16 00		34 50	1,122 84			1,642 11
Furniture for Government houses and offices in navy-yards	111 26	6 70		1,980 11	313 59	261 96	708 11	15 45				3,397 18
Coal and other fuel for yards and docks purposes	4,156 38	67 17	118 50	3,104 29	348 33	1,631 36	230 18	133 34	13 00			9,806 55
Candles, oil, and gas	1,191 47	2,053 42	10 00	2,147 70	138 01	714 20	2,862 63	132 49	4,488 75	30 00		13,768 67
Cleaning and clearing up yards and care of buildings	785 67	1,700 68		6,499 53	212 47	7,078 58	613 33	428 12	6,234 25			23,552 63
Attendance on fires, lights, fire-engines, and apparatus	2,351 16	1,110 02		4,650 88	1,095 69	1,899 69	2,901 66		2,697 56			16,706 66
Incidental labor, not chargeable to other appropriations	5,807 49	415 84	200 00	3,090 17	2,737 19	1,820 00	1,406 28		2,615 00		$645 00	18,736 97
Water tax	100 00	2,296 28		4,527 23			52 30		495 25	73 00		7,544 06
Tolls and ferriages			14 00	117 60			180 00		2,760 00			3,071 60
Pay of watchmen	8,283 16	4,923 84	744 00	12,841 60	492 00	5,408 92	11,473 28	2,406 33	2,562 00	1,336 25		50,471 38
Flags, awnings, and packing-boxes	41 51	61 73		7 40	49 07	12 85	90 47			24 00		287 03
Rent of landings	137 50											137 50
Pay of teamsters		1,380 00										1,380 00
Total	27,240 84	16,854 50	1,347 00	50,345 67	7,732 77	23,193 24	31,089 34	5,109 94	36,309 64	1,507 75	645 00	201,375 69

No. 4.—*Detailed report of expenditures under "closed navy-yards" received from yards during the fiscal year ending June 30, 1884.*

Objects.	Boston.	New London.	League Island.	Pensacola.	Total.
Yard buildings	$1,328 22	$12 11	$768 91	$2,427 61	$4,536 85
Officers' quarters	813 34	46 38	168 47	1,522 75	2,550 94
Wharves, bridges, landings, and boats	191 17		35 39	19 05	245 61
Roads, walks, gutters, and drains	3,994 61	24 04	1,945 68	171 46	6,135 79
Fences and walls	45 88		2 06	20 50	68 44
Cranes, scows, and derricks			19 07	254 14	273 21
Furnaces, forges, stoves, and heating apparatus	2,964 81		25 33	1,604 77	4,594 91
Tracks and scales	57 88				57 88
Water and gas works	1,818 33		38 30	33 60	1,890 23
Dry-dock	203 56			1,109 01	1,312 57
Miscellaneous repairs	2,086 23	78 00	10,212 40	613 74	12,990 37
Watch, teamsters, and incidental labor	8,326 56				8,326 56
Purchase and maintenance of oxen and horses pay of hired teams, &c		478 35			478 35
Carts, timber-wheels, and tools of every description		6 75			6 75
Postage on letters on public service and telegrams		4 00			4 00
Furniture for Government houses and offices in navy yards		41 27			41 27
Candles, oil, and gas		11 30			11 30
Attendance on fires, lights, fire-engines, and apparatus				91 20	91 20
Incidental labor not chargeable to other appropriations		521 00			521 00
Tolls and ferriage		14 00			14 00
Pay of watchmen		1,458 00		3,790 56	5,248 56
Flags, awnings, and packing-boxes				30 79	30 79
Total	21,830 59	2,695 20	13,215 61	11,689 18	49,430 58

No. 5.—*Estimates received from navy-yards, stations, and Naval Asylum for fiscal year ending June 30, 1886.*

Yards and stations.	Appropriations.				
	Yard improvements.	Repairs and preservation.	General maintenance.	Civil establishment.	Total.
Portsmouth, N. H	$25,000 00	$65,500 00	$49,400 00	$5,617 25	$145,517 25
Boston, Mass	2,853,642 17	370,500 00	74,800 00	7,256 25	3,306,198 42
New London, Conn		1,200 00	5,650 00		6,850 00
New York, N. Y	1,811,000 00	242,000 00	128,000 00	8,200 00	2,189,200 00
League Island, Pa	936,366 42	134,000 00	80,000 00	9,700 00	1,160,066 42
Washington, D. C	166,711 00	43,500 00	51,720 00	3,917 25	265,848 25
Norfolk, Va	1,139,077 84	147,930 09	84,351 53	6,734 50	1,378,093 96
Pensacola, Fla		6,850 90	14,630 50	939 00	22,420 40
Mare Island, Cal	709,812 94	141,000 00	76,500 00	6,900 00	934,212 94
Sackett's Harbor, N. Y		1,000 00			1,000 00
Key West, Fla	15,000 00	6,355 70	1,789 50		23,145 20
Naval Asylum, Pa	98,111 00				98,111 00
Total	7,754,721 37	1,159,836 69	566,841 53	49,264 25	9,530,663 84

No. 6.—*Detailed estimates from yards and stations for works of improvement for the fiscal year ending June 30, 1886.*

Yards, stations, and objects.	Estimates.	Total.
PORTSMOUTH, N. H.		
For water-works	$25,000 00	$25,000 00
BOSTON, MASS.		
For iron-plater s shop	120,713 89	
For water-pipes	49,607 00	
For cart-shed	10,408 45	
For erecting and copper shop	39,864 90	
For paving and grading	43,109 40	
For floating gate, dry dock	31,883 75	
For officers' quarters, L, M, N, and O	28,610 00	
For rebuilding wharves	74,244 78	
For additional dry-docks	2,455,200 00	2,853,642 17
NEW YORK, N. Y.		
For yards and docks building for general storage	85,000 00	
For boiler-shop wing to machine-shop	137,000 00	
For shipwrights' shed	14,000 00	
For paint-shop	20,000 00	
For dry-dock caisson	30,000 00	
For repairs to dry-dock	125,000 00	
For bulkhead, causeway, and continuation of cob-dock improvement	200,000 00	
For timber, dry-dock	1,200,000 00	1,811,000 00
LEAGUE ISLAND, PA.		
For storehouse for ordnance	182,414 47	
For storehouse for provisions and clothing	209,237 84	
For storehouse for equipment and recruiting	209,237 84	
For office building, yard paymaster	19,579 29	
For office building, medicine and surgery	19,579 29	
For office building, commandant	53,735 59	
For dwellings B and C	30,582 85	
For dwellings D and E	30,582 85	
For landing-wharf, foot of Fifteenth street (75 by 400 feet)	26,416 40	
For dredging and filling in	155,000 00	936,366 42
WASHINGTON, D. C.		
For new ordnance machine-shop	95,000 00	
For extension of yard wall	21,711 00	
For continuation of dredging	25,000 00	
For extension of yard and purchase of squares 853 and 826	25,000 00	166,711 00
NORFOLK, VA.		
For dry-dock extension	240,062 34	
For new pumps for dry-dock	52,600 00	
For extension of quay wall	384,400 00	
For railroad extension	47,479 87	
For plant for electric lights	7,600 00	
For erecting shop No. 41	34,073 45	
For extension of boiler-shop No. 23	14,488 29	
For marine railway	102,481 20	
For floating derrick	49,189 71	
For chain and cordage store, No. 63	41,710 94	
For coal-house, No. 54	77,565 62	
For store-houses, Nos. 34 and 35	77,426 42	1,139,077 84
MARE ISLAND, CAL.		
For completion of stone dry-dock	360,000 00	
For timber-shed, site No. 94	13,085 05	
For cisterns	46,346 30	
For rolling mill for steam engineering	40,000 00	
For boiler-shop floor for steam engineering	4,200 00	
For wharves	93,000 00	
For roads	42,517 50	
For landings	5,000 00	
For sewers	7,000 00	
For gate-house and guard-house	20,000 00	
For artesian well	10,000 00	
For gas holder	16,664 09	
For gas-pipes and mains	8,000 00	
For iron crane	40,000 00	
For iron-plating shop	4,000 00	709,812 49

No. 6.—*Detailed estimates from yards and stations for works of improvement, &c.*—Cont

Yards, stations, and objects.	Estimates.	Total.
KEY WEST, FLA.		
For the purchase of the Mallory lot	$15,000 00	$15,00
NAVAL ASYLUM, PHILADELPHIA.		
For the support of beneficiaries, improvements, and all expenses	98,111 00	98,111
Total improvements		7,754,721

No. 7.—*Detailed estimates from navy-yards and stations for "repairs and preservation" for the fiscal year ending June* 30, 1886.

Objects.	Portsmouth.	Boston.	New London.	New York.	League Island.	Washington.	Norfolk.	Pensacola.	Mare Island.	Sackett's Harbor.	Key West.	Total.
Yard buildings	$20,000 00	$150,000 00	$300 00	$75,000 00	$29,481 30	$15,000 00	$51,534 57	$2,059 18	$7,000 00		$887 70	$351,262 75
Officers' quarters	3,000 00	3,000 00	300 00	15,000 00	998 20	2,000 00	2,028 11		4,000 00			30,326 31
Wharves, bridges, landings, and boats	5,000 00	15,000 00	200 00	50,000 00	21,603 75	1,500 00	45,356 91	474 36	8,000 00		1,650 00	148,785 02
Roads, walks, gutters, and drains	2,000 00	22,500 00	100 00	20,000 00	1,072 50	4,000 00	17,126 03	534 18	25,000 00			92,332 71
Fences and walls	500 00	5,000 00	150 00	10,000 00	252 30	250 00	5,333 55	3,314 33	3,000 00			27,800 18
Cranes, scows, and derricks	2,000 00	115,000 00		20,000 00	1,655 50	500 00	5,504 02		10,000 00			154,659 52
Furnaces, forges, and heating apparatus, &c	2,500 00	5,000 00	50 00	5,000 00	1,272 00	12,750 00	571 15		2,000 00			29,143 15
Tracks and scales	500 00	10,000 00		12,000 00	5,625 00	4,500 00	2,886 58		2,000 00		1,702 00	39,213 58
Water and gas works	3,000 00	15,000 00		5,000 00	2,651 00	3,000 00	5,799 03		10,000 00			44,450 03
Dredging and scowing		5,000 00		10,000 00	12,153 00		5,578 89		3,000 00			35,731 89
Dry-docks	*20,000 00	15,000 00					3,483 80		†60,000 00			98,483 80
Miscellaneous repairs	7,000 00	10,000 00	100 00	20,000 00	27,235 45		2,727 45	468 85	7,000 00	$1,000 00	1,000 00	76,531 75
Cisterns											1,116 00	1,116 00
Dikes					30,000 00							30,000 00
Total	65,500 00	370,500 00	1,200 00	242,000 00	134,000 00	43,500 00	147,930 09	6,850 90	141,000 00	1,000 00	6,355 70	1,159,836 69

* Dry-dock and ways.

† Sectional dock.

No. 8.—*Detailed estimates for "general maintenance" received from yards and stations for the fiscal year ending June 30, 1886.*

Objects.	Portsmouth.	Boston.	New London.	New York.	League Island.	Washington.	Norfolk.	Pensacola.	Mare Island.	Key West.	Total.
Freight and transportation	$100 00	$200 00	$25 00	$500 00	$100 00	$20 00	$100 00	....	$5,000 00	....	$6,045 00
Printing, stationery, and advertising	600 00	500 00	100 00	1,000 00	1,000 00	600 00	450 00	$250 00	1,500 00	....	6,000 00
Books, maps, models, and drawings	200 00	100 00	....	1,000 00	1,000 00	50 00	1,074 50	....	1,500 00	....	4,924 50
Purchase and repair of fire-engines	2,000 00	1,000 00	....	5,000 00	3,842 10	8,000 00	2,859 25	2,302 50	3,000 00	....	28,003 85
Machinery of every description and patent rights	....	500 00	....	10,000 00	4,825 00	900 00	4,068 25	....	3,000 00	....	23,293 25
Repairs on steam-engines and attendance on same	500 00	2,500 00	....	2,500 00	1,197 20	500 00	10,563 41	2,302 00	1,500 00	....	21,562 61
Purchase and maintenance of oxen and horses, pay of hired teams, &c	6,000 00	15,000 00	775 00	20,000 00	12,555 00	5,000 00	15,113 42	....	8,000 00	....	82,443 42
Carts, timber-wheels, and tools of every description	2,500 00	8,500 00	200 00	10,000 00	13,882 38	2,500 00	10,903 68	....	3,000 00	....	51,486 06
Postage on letters on public service and telegrams	150 00	100 00	20 00	1,000 00	1,000 00	50 00	25 00	....	1,500 00	....	3,845 00
Furniture for Government houses and offices in navy-yards	2,500 00	1,500 00	....	5,000 00	2,770 00	3,000 00	8,887 61	550 00	6,000 00	....	30,207 61
Coal and other fuel for yards and docks purposes	5,000 00	4,000 00	100 00	5,000 00	5,950 00	2,000 00	1,760 50	....	2,000 00	....	25,810 50
Candles, oil, and gas	3,000 00	3,000 00	40 00	4,000 00	660 00	1,500 00	3,425 00	650 00	5,000 00	....	21,275 00
Cleaning and clearing up yards and care of buildings	6,000 00	15,000 00	....	20,000 00	6,500 00	8,000 00	7,141 52	614 00	7,000 00	....	70,255 52
Attendance on fires, lights, fire-engines and apparatus	5,000 00	3,700 00	....	6,000 00	8,500 00	2,500 00	3,676 85	....	3,000 00	....	32,376 85
Incidental labor, not chargeable to other appropriations	7,000 00	2,000 00	2,000 00	10,000 00	8,113 12	5,000 00	2,001 64	....	5,000 00	$453 25	41,568 01
Water tax	100 00	5,000 00	....	6,000 00	....	....	45 00	168 00	5,000 00	....	16,313 00
Tolls and ferriages	50 00	....	40 00	500 00	....	....	200 00	....	3,000 00	....	3,790 00
Pay of watchmen	8,500 00	12,000 00	2,300 00	20,000 00	7,300 00	12,000 00	11,504 80	7,578 00	12,000 00	1,336 25	94,519 05
Flags, awnings, and packing-boxes	200 00	200 00	50 00	500 00	805 20	100 00	551 10	216 00	500 00	....	3,122 30
Total	49,400 00	74,800 00	5,650 00	128,000 00	80,000 00	51,720 00	84,351 53	14,630 50	76,500 00	1,789 50	566,841 53

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Yards and Docks, Navy Department.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year, ending June 30, 1885.
SALARIES.			
One chief clerk (increase of $450, submitted, making the salary equal to the pay of chief clerks of the other offices of the Executive Departments), per act July 7, 1884	$2,250 00		$1,800 00
One draughtsman and clerk, same act	1,800 00		1,800 00
One clerk of class four, same act	1,800 00		1,800 00
One clerk of class three, same act	1,600 00		1,600 00
One clerk of class two, same act	1,400 00		1,400 00
One clerk of class one, same act	1,200 00		1,200 00
One clerk, same act	1,000 00		1,000 00
One messenger, same act	720 00		720 00
One laborer, same act	660 00		660 00
		12,430 00	
Restoring clerk of class two to pay previously given—(submitted)	200 00		
Restoring clerk of class one to pay previously given (submitted)	200 00		
Restoring clerk of $1,000 to pay previously given (submitted)	200 00		
Restoring messenger to pay previously given (submitted)	120 00		
Restoring laborer to pay previously given (submitted)	60 00		
		780 00	
		13,210 00	11,980 00
CONTINGENT EXPENSES.			
Stationery, books, plans, drawings, incidental labor and miscellaneous items, per act July 7, 1884	600 00	600 00	600 00
		13,810 00	12,580 00
NOTE.—The salaries of three clerks, one messenger, and one laborer have been estimated for in accordance with the law approved March 3, 1877.			
GENERAL MAINTENANCE.			
For general maintenance of yards and docks, namely: For freight and transportation of materials and stores; books, maps, models, and drawings; purchase and repair of fire engines, machinery, and patent right to use the same; repairs of steam fire-engines and attendance on the same; purchase and maintenance of oxen and horses and driving teams, carts, and timber wheels, and all vehicles for use in navy-yards; tools and repairs of the same; dredging, postage on letters and other mailable matter on public service and telegrams; furniture for Government houses and offices in navy-yards; coal and other fuel, candles, oil, and gas; cleaning and clearing up yards, and care of public buildings; attendance on fires, lights, fire-engines, and apparatus; for clerical and incidental labor at navy-yards; water tax, tolls, and ferriages; rent of officers' quarters at League Island; pay of watchmen in navy-yards: for awnings, and packing-boxes, and advertising for yards and docks purposes, per act of July 7, 1884	$425,289 00		*110,000 00
CONTINGENT, YARDS AND DOCKS.			
For contingent expenses that may arise at navy-yards and stations, per act of July 7, 1884	25,000 00		*10,000 00
	450,289 00		120,000 00
NAVAL ASYLUM.			
One superintendent, per act of July 7, 1884	600 00		
One steward (increase of $120 submitted, same act	600 00		
One matron (increase of $120 submitted), same act	480 00		
One chief cook (increase of $120 submitted), same act	360 00		
Two assistant cooks (increase of $72 submitted), same act	480 00		
One chief laundress, same act	192 00		
Six laundresses, same act	1,008 00		
Four scrubbers (increase of three submitted), same act	672 00		
Eight waiters (increase of three submitted), same act	1,344 00		
Six laborers, same act	1,440 00		
One stable-keeper and driver, same act	360 00		
One master-at-arms (increase of $120 submitted), same act	600 00		

* For six months

Estimate of appropriations required by the Bureau of Yards and Docks, &c.—**Continue**

Detailed objects of expenditure, and explanation.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30,
NAVAL ASYLUM—continued.			
Two house corporals (increase of $120 submitted), same act	$720 00		
One barber, same act.	360 00		
One carpenter, same act	845 00		
		$10, 061 00	*$4, 25
For water rent and gas, same act	2, 000 00		
For cemetery, burial expenses, and head-stones, same act	350 00		
For improvement of grounds, same act	500 00		
For repairs to buildings, for furnaces, grates, ranges, and furniture, and repairs of same, same act	8, 000 00		
For car tickets, same act	200 00		
For music in chapel (submitted)	600 00		
For erecting brick building for kitchen, laundry, and servants' quarters (submitted)	20, 000 00		
		31, 650 00	
For fitting up bath-room with twelve tubs for beneficiaries	800 00		
For removing laundry boilers and tubs to new building, and plumbing	400 00		
For kitchen range for new building	800 00		
For support of beneficiaries	54, 400 00		
		56, 400 00	† 25, 65
		98, 111 00	29, 90
REPAIRS AND PRESERVATION.			
For navy-yards and stations, per act July 7, 1884	838, 200 00	838, 200 00	125, 00
FOR NAVY-YARDS AND STATIONS.			
Navy-yard, Portsmouth, N. H.:			
For water works (submitted)	10, 000 00	10, 000 00	....
Navy-yard, Boston, Mass.:			
For floating-gate for dry-dock (submitted)	31, 883 00	31, 883 00	....
Navy-yard, New York:			
For dry-dock caisson (submitted)	30, 000 00	....	....
For repairs to dry-dock (submitted)	125, 000 00	....	....
For continuation of cob-dock improvement, per act of July 7, 1884	50, 000 00	....	47,
For dredging, per act of July 7, 1884	30, 000 00	235, 000 00	30,
Navy-yard, Washington, D. C.:			
For continuation of dredging	25, 000 00	25, 000 00	....
Navy-yard, Mare Island, Cal.:			
For completion of stone dry-dock (submitted), per act of July 7, 1884	360, 000 00	....	250, 00
For sewers (submitted)	7, 000 00	....	....
For continuing artesian well (submitted)	10, 000 00	....	....
For iron crane (submitted)	40, 000 00	417, 000 00	....
Naval station, Key West, Fla.:			
For purchase of Mallory lot (submitted)	15, 000 00	15, 000 00	....
	....	733, 883 00	327, 36
Navy-yard, Portsmouth, N. H.:			
For water-works (submitted)	15, 000 00		
		15, 000 00	
Navy-yard, Boston, Mass.:			
For iron plater's shop (submitted)	120, 713 89		
For water pipes (submitted)	49, 607 00		
For cart shed (submitted)	10, 408 45		
For rebuilding wharves (submitted)	74, 244 78		
		254 974 12	
Navy-yard, New York, N. Y.:			
For yards and docks, building for storage (submitted)	85, 000 00		
For boiler-shop wing to machine shop (submitted)	137, 000 00		
For shipwright's shed (submitted)	14, 000 00		
For timber dry-dock (submitted)	1, 200 000 00		
		1, 436 000 00	
Navy-yard, League Island, Pa.:			
For landing wharf foot of Fifteenth street, 75 by 400 feet (submitted)	26, 416 40		
For dredging and filling in (submitted)	155, 000 00		
		181, 416 40	
Navy yard, Washington, D. C.:			
For New ordnance machine-shop (submitted)	95, 000 00		
For extension of yard wall (submitted)	21, 711 00		
For extension of yard and purchase of squares 853 and 826 (submitted)	25, 000 00		
		141, 711 00	

* For six months ending December 31, 1884. † For six months.

Estimate of appropriations required by the Bureau of Yards and Docks, &c.—Continued.

Detailed objects of expenditure, and explanation.	Estimated amount which will be required for each detailed object of appropriation.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1885.
FOR NAVY-YARDS AND STATIONS—continued.			
Navy-yard, Norfolk, Va.:			
For dry-dock extension (submitted)	$240,062 34		
For new pump for dry-dock (submitted)	52,600 00		
For extension of quay wall, (submitted)	384,400 00		
For railroad extension (submitted)	47,479 87		
For floating derrick (submitted)	49,189 71		
		$773,731 92	
Navy-yard, Mare Island, Cal.:			
For timber shed, site No. 94 (submitted)	13,085 05		
For cisterns (submitted)	46,346 30		
For rolling-mill for steam engineering (submitted)	40,000 00		
For boiler-shop floor for steam engineering (submitted)	4,200 00		
For wharves (submitted)	93,000 00		
For roads (submitted)	42,517 50		
For gate house and guard house (submitted)	20,000 00		
For iron-plating shop (submitted)	4,000 00		
		263,148 85	
		3,065,982 29	
CIVIL ESTABLISHMENT.			
Navy-yard, Portsmouth, N. H.:			
One clerk to civil engineer (submitted) per act July 7, 1884	1,400 00		
One store clerk (submitted); same act	1,300 00		
One writer and assistant draughtsman (submitted); same act	1,200 00		
One mail messenger; same act	700 00		
		4,600 00	
Navy-yard, Boston, Mass.:			
One clerk to civil engineer; same act	1,500 00		
One draughtsman; same act	1,500 00		
One store clerk; same act	1,400 00		
One writer, commandant's office; same act	1,017 25		
One writer, civil engineer's office; same act	939 00		
One messenger and mail carrier; same act	900 00		
		7,256 25	
Navy-yard, Brooklyn, N. Y.:			
One clerk to civil engineer; same act	1,400 00		
One draughtsman; same act	1,500 00		
One store clerk; same act	1,300 00		
One muster and time clerk; same act	1,200 00		
One writer; same act	1,000 00		
		6,400 00	
Navy-yard, League Island, Pa.:			
One chief clerk (submitted), per act July 7, 1884	1,600 00		
One store clerk (submitted)	1,500 00		
One time clerk (submitted)	1,500 00		
One draughtsman (submitted)	1,600 00		
One writer (submitted)	1,000 00		
One mail messenger (submitted)	700 00		
		7,900 00	
Navy-yard, Washington, D. C.:			
One clerk to civil engineer (submitted)	1,400 00		
One store clerk (submitted)	1,300 00		
One writer (submitted)	1,017 25		
		3,717 25	
Navy-yard, Norfolk, Va.:			
One clerk to civil engineer (submitted)	1,400 00		
One store clerk (submitted)	1,300 00		
One draughtsman (submitted)	1,400 00		
One writer to civil engineer (submitted)	1,017 25		
One writer to commandant (submitted)	939 00		
One mail messenger (submitted)	600 00		
		6,656 25	
Navy-yard, Pensacola, Fla.:			
One clerk (submitted)	1,300 00		
One store clerk (submitted)	1,200 00		
		2,500 00	
Navy-yard, Mare Island, Cal.:			
One clerk to civil engineer (submitted), per act July 7, 1884	1,500 00		
One store clerk (submitted), per act July 7, 1884	1,400 00		
Two writers at $1,200 each (submitted), per act July 7, 1884	2,400 00		
One draughtsman (submitted), per act July 7, 1884	1,600 00		
		6,900 00	
		45,929 75	*$12,000 00

* For six months.

ABSTRACT OF OFFERS FOR SUPPLIES RECEIVED FOR FURNISHING ARTICLES COMING UNDER THE COGNIZANCE OF THE BUREAU OF YARDS AND DOCKS, MADE IN CONFORMITY TO THE ACT OF CONGRESS APPROVED MARCH 3, 1843.

Schedule of offers for supplies for navy-yard at Portsmouth, N. H., under advertisement dated August 7, 1883.

BITUMINOUS COAL.

Joseph Sise	$4,400 45
C. E. Walker & Co	*4,090 37½
J. Albert Walker	†4,223 00

Schedule of offers for supplies for navy-yard at Portsmouth N. H., under advertisement dated October 10, 1883.

PROVENDER.

T. Furbish	$336 00
William A. Plaisted	*225 00
E. J. Wilson	332 25
Chandler Brooks	229 95

Scale of offers for supplies for navy-yard at Portsmouth, N. H., under advertisement dated May, 1884.

FIFTEEN TONS ENGLISH HAY.

C. W. Cattle & Son	$192 75
E. I. Wilson	187 35
James D. Plaisted	194 10
E. C. Spinney	*179 25
T. Furbish	193 90

CORN MEAL AND OATS.

William A. Plaisted	*146 10
J. Brooks & Co	146 10

Scale of offers for supplies for navy-yard at Portsmouth, N. H., under requisitions Nos. 48 *and* 49, *May*, 1884.

TIMBER AND BOARDS

George A. Hammond	$642 84
John H. Broughton	*603 42

RED-OAK PILES.

George A. Hammond	*200 00
John H. Broughton	210 00
E. C. Spinney	220 00
S. L. Adams	250 00

HAIR AND CEMENT.

J. Albert Walker	31 05
John H. Broughton	*28 50

MISCELLANEOUS ARTICLES.

W. J. Sampson & Co	246 50
A. L. Cutter & Co	*228 40
Rider & Cotton	230 45

ALCOHOL AND OILS.

Rider & Cotton	*90 00
W. A. Wood & Co	91 80

*Awarded. †Informal.

SLATING NAILS.

Rider & Cotton	*$30 00
G. T. Vaughn & Co	37 50

MISCELLANEOUS.

Rider & Cotton	*79 85
G. T. Vaughn & Co	80 55

Schedule of offers for supplies for navy-yard at Boston, Mass., under advertisement September 3, 1883.

COAL.

C. A. Campbell	*$2,461 50
J. A. Wellington & Co	2,705 00

Schedule of offers for supplies for navy-yard at Brooklyn, N. Y., under advertisement August 25, 1883.

ANTHRACITE COAL.

Charles H. Bass	*2,488 50
George H. Creed	2,557 50
D. Babcock & Co	2,552 00

Schedule of offers for dredging at the Brooklyn navy-yard, dated October 26, 1883.

DREDGING.

	Per cubic yard.
Union Dredging Company, C. H. Loomis, superintendent	$0 27
Morris & Cumming's Dredging Company	25
National Dredging Company, F. B. Colton, manager	26
Atlantic Dredging Company, R. G. Packard, president	*24⅞

Schedule of offers for supplies for navy-yard at Washington, D. C., under advertisement August 8, 1883.

1,000 TONS CUMBERLAND COAL.

	Per ton.	
S. M. Hamilton & Co	$2 97	$2,970
Wheatley & Bros	3 80	3,800
John Miller	3 78	3,780
Johnson Bros	2 93	*2,930
J. S. Killmon	2 95	2,950
O. Z. Muncaster	3 17½	3,175
W. G. Wheatly	2 99	2,990

Schedule of offers for the Ox "Buck" at the navy-yard, Washington, D. C., October 3, 1883.

OX "BUCK."

J. Dreifus & Co	$66 50
B. H. Lusby	67 50
P. E. Koenig	68 00
John Koenig	55 00
Charles E. Sanderson	†68 55

Schedule of offers for supplies for navy-yard at Norfolk, Va., approved August 6, 1883, *opened August* 17.

PROVENDER.

A. H. Lindsay	*$1,012 21
Evans, Burwell & Tazwell	1,021 73

* Awarded. † Accepted.

Schedule of offers for supplies for navy-yard at Norfolk, under advertisement December 17, 1883.

PROVENDER.

Evans, Burwell & Tazewell	*$1,547 00
A. H. Lindsay	1,578 54

Schedule of offers for supplies for navy-yard at Norfolk, Va., under advertisement dated February 11, 1884.

100,000 BUSHELS OYSTER SHELLS.

A. A. McCullough, at 2½ cents	$2,500 00
George L. Neville, at 3 cents	3,000 00
J. Walkins, at 4 cents	4,000 00
E. J. Cannon, at 2.93 cents	2,930 00
Evans, Burwell & Tazewell, at 2.49 cents	2,490 00
Johnson & Bro., at 2¼ cents	*2,250 00
Nottingham & Wrenn, at 3 cents	3,000 00

Scale of offers for supplies for navy-yard at Norfolk, Va., under advertisement April 14, 1884.

CYPRESS PILES, PINE, ETC.

G. Armstrong & Son	$1,962 50
G. L. Neville	1,950 00
R. J. Neeley & Co	1,957 00
A. A. McCollough	*1,790 50

Schedule of offers for supplies for navy-yard at Norfolk, Va., under advertisement dated May 22, 1884.

CUMBERLAND COAL.

George W. Taylor & Co	$745 00
J. H. Peters	842 50
A. A. McCullough	725 00
George McBlair	*715 00

ANTHRACITE COAL.

George W. Taylor & Co	$473 00
J. H. Peters	559 00
A. A. McCullough	525 00
George McBlair	*440 00

Scale of offers for supplies for navy-yard at Norfolk, Va., under advertisement June 5, 1884.

100,000 BRICKS.

Murdaugh & Mayo	$1,200 00
George E. Neville	*1,135 00

PUMP, OILS, ETC.

Mayer & Co	*$815 75
George E. Neville	887 96

Scale of offers for supplies for navy-yard at Pensacola, Fla., on requisition No. 13, *February* 12, 1884.

WHITE LEAD, OILS, ETC.

McKensie Oerting & Co	*$115 25
J. O'Neal	117 25

*Awarded.

Scale of offers for one mule to be sold at the navy-yard at Pensacola, Fla., under advertisement dated March 17, 1884.

E. L. Hoffmaister	*$125 00
J. O'Neal	50 00
J. M. Tarble	100 00
James Brown	80 00

Scale of offers for supplies for navy-yard at Pensacola, Fla., on requisition No. 14, March 17, 1884.

LINSEED OIL.

McKensie Oerting & Co	*$14 70
J. O'Neal	18 75

LAMP CHIMNEYS.

McKensie, Oerting & Co	*$4 50
J. O'Neal	7 00

Scale of offers for supplies for navy-yard at Pensacola, Fla., on requisition No. 15, approved April 5, 1884.

42 GALLONS LINSEED OIL.

McKensie, Oerting & Co	*$32 34
J. O'Neal	33 18

Scale of offers for supplies for navy-yard at Pensacola, Fla., requisition No. 16, April 15, 1884.

8 BARRELS LIME.

J. O'Neal	$16 00
F. Bauer	*14 00

Scale of offers for supplies for navy-yard at Pensacola, Fla., requisition No. 18, approved April 22, 1884.

PROVENDER.

J. O'Neal	*$145 30
F. Bauer	148 84

Scale of offers for supplies for navy-yard at Pensacola, Fla., approved May 9, 1884.

PAINTS AND OILS.

McKensie, Oerting & Co	$38 05
J. O'Neal	*37 85

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated July 16, 1883.

1,600 CUBIC YARDS SAND.

Aden Bros	*$1,234 00
A. Ketelson	1,625 00
A. Powell	1,650 00
H. M. Peterson	1,850 00

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement August 2, 1883.

PROVENDER.

A. Powell	$1,977 00
Kelly & McInnis	2,152 50
E. & O. Conner	2,667 60
James McCudden	*1,933 00
James Brownlie	2,076 50
P. C. Lynch	1,945 00
William Walker	2,351 00

*Awarded.

WELLINGTON COAL.

A. Powell	$1,250
James McCudden	*1,150
William Walker	1,[illegible]

Scale of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated August 11, 1883.

PAINTS AND OILS.

Sullivan & Rabekes	$549 93
Whittier, Fuller & Co	*508 53

PINE TIMBER, ETC.

James McCudden	*1,120 00
John P. Sheldon	1,200 00
A. Powell	1,200 00

GLASS.

Sullivan & Ravekes	52 50
Whittier, Fuller & Co	*46 60

LUMBER.

James McCudden	*823 00
John P. Sheldon	850 00
A. Powell	890 00

IRON.

James E. Gordon	180 75
Huntingdon, Hopkins & Co	*168 58
Whitney & Marshall	†174 97

IRON.

James E. Gordon	158 81
Huntingdon, Hopkins & Co	*145 94
Whitney & Marshall	†146 71

TIN, METAL AND ACID.

James E. Gordon	*246 25
Huntington, Hopkins & Co	250 28

CUMBERLAND COAL.

James McCudden	*320 00
A. Powell	360 00

CUMBERLAND COAL.

James McCudden	*80 00
A. Powell	90 00

MISCELLANEOUS.

James E. Gordon	301 40
Huntington, Hopkins & Co	*281 41

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated September 4, 1883.

BRICK.

James McCudden	*$1,416 00
A. Powell	1,440 00

*Awarded. †Informal.

OILS, PAINTS, ETC.

Whittier, Fuller & Co	*$229 00
Charles M. Yates	242 87

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated September 18, 1883.

CHERRY RED BRICK.

James McCudden	*$3,009 00
A. Powell	3,264 00

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated September 28, 1883.

STEEL.

Thomas H. Selby & Co	*$292 50

WATER BUCKETS.

No bids received.

TIN AND ZINC.

Thomas H. Selby & Co	157 50
A. J. Ralston	*150 00

IRON.

James McCudden	*870 00
Thomas H. Selby & Co	892 50

COAL.

James McCudden	*330 00
A. Powell	330 00
William Walker	339 00

Schedule of offers for floating gate or caisson and for pumping-machinery for navy-yard at Mare Island, Cal., under advertisement dated November 12, 1883.

FLOATING GATE OR CAISSON.

Union Iron Works, H. T. Scott, vice-president, California; time, six months for completion	*$56,000 00
Pacific Iron Works, Rankin, Brayton & Co., California; time, six months.	72,500 00
Risdon Iron Works, W. H. Taylor, president, California; time, seven months	73,500 00

PUMPING-MACHINERY.

James Edwards & Co.; no time stated	74,250 00
Union Iron Works, H. T. Scott, vice-president; time, seven months	50,600 00
Southwark Foundry Company, Philadelphia, J. V. Merrick, vice-president; time, eight months	*47,900 00
Daniel C. Buhre & Co., Brooklyn; time, twelve months	69,700 00
Thomas C. Basshor & Co., Baltimore, Md.; no time named	75,000 00
Parke & Lacey, San Francisco	†42,200 00

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated November 17, 1883.

IRON BOILER TUBES.

James E. Gordon	‡$486 00
George H. Gibbs & Co	496 00
Thomas H. Selby & Co	504 22

*Awarded. †Received too late. ‡Informal.

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated December 21, 1883.

100 TONS WELLINGTON COAL.

James McCudden	*$1,230 00
William Walker	1,290 00
A. Powell	1,300 00

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated December 27, 1883.

500 CUBIC YARDS BEACH SAND.

Aden Bros	$370 00
A. Ketelson	450 00
James McCudden	425 00

100 CUBIC YARDS FRESH-WATER SAND.

Aden Bros	*$123 00
A. Ketelson	125 00
James McCudden	125 00

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated February 8, 1884.

LIME.

A. Powell	*$247 50
Aden Bros	300 00
Blockman & Cerf	256 50
James McCudden	300 00

OIL.

L. Fourd	50 00
Yates & Co	*30 00

ROPE.

L. Fourd	610 55
Heath, Gallup & Co	*555 00

SPUN YARN.

L. Fourd	36 25
Heath, Gallup & Co	*35 00

REDWOOD.

A. Powell	*55 00
James McCudden	56 00

Schedule of offers for supplies for the navy-yard at Mare Island, Cal., under advertisement dated February 18, 1884.

IRON AND STEEL PLATE, TUBES, ETC.

Thomas H. Selby & Co	†$541 60
George W. Gibbs & Co	*618 65

IRON PLATE.

Thomas H. Selby & Co	†208 73
George W. Gibbs & Co	*227 70

* Awarded. † Could not deliver in time.

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement April 21, 1884.

PILES.

James McCudden	*$1,680 00
John P. Sheldon	1,[illegible]00 00
A. Powell	1,800 00
Renton, Holmes & Co	†1,740 00

LUMBER.

James McCudden	*1,510 90
John P. Sheldon	1,561 44
A. Powell	1,563 00
Renton, Holmes & Co	†1,510 90

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement May 2, 1884.

STEEL RIVETS, TUBES, ETC.

James E. Gordon	$991 84
Thomas H. Selby & Co	*973 23

Schedule of offers for supplies for navy-yard at Mare Island, Cal., under advertisement dated May 6, 1884.

PILES.

James McCudden	*$1,666 00
John P. Sheldon	1,785 00
A. Powell	1,725 50

LUMBER.

James McCudden	*2,626 70
John P. Sheldon	2,712 76
A. Powell	2,626 70

* Awarded. † Informal.

No. 5.—BUREAU OF EQUIPMENT AND RECRUITING.

NAVY DEPARTMENT,
BUREAU OF EQUIPMENT AND RECRUITING,
Washington, October 24, 1884.

SIR: I have the honor to submit herewith the following report of the operations of this Bureau during the past fiscal year, with accompanying estimates for the fiscal year ending June 30, 1886.

During the past fiscal year 66 vessels have been either wholly or partially equipped, under cognizance of this Bureau, at the several navy-yards, involving an expenditure for labor of $89,052.40, and for materials $550,279.52, making a total of $639,331.92.

The sum of $896,000 is asked for under appropriation "Equipment of vessels," as actually necessary for the fitting out and keeping in repair the number of vessels contemplated to be kept in commission during the ensuing fiscal year. For the past two years it has been necessary to ask for a deficiency under this appropriation, Congress having failed to appropriate the estimated amounts, and those which were appropriated being inadequate to the actual expenses of the service.

The amounts estimated for under the appropriations "Transportation and recruiting" and "Contingent" are each increased $10,000 over the sums allowed under those appropriations for the past year. This increase is absolutely required to meet the necessities of the service, or deficiencies must inevitably arise. This has occurred for the past year, and the Bureau is thereby very much embarrassed, particularly as regards the transportation of men. Although the law allows transportation under the War and Navy Departments to be procured without adequate appropriation when the exigencies of the service require it, the Bureau is placed in an undesirable position as regards the parties by whom the transportation is furnished. Not having funds at disposal to pay for the necessary transportation of men when the service has been performed, the Bureau is obliged to ask the various companies to wait for a greater or less period of time for their money. Enlisted men must be transported when required, and experience for the last two years having proved the insufficiency of the sums appropriated for this service, this increase is respectfully submitted and urged.

Under appropriation "Increase of the Navy" the Bureau has estimated as follows:

To furnish complete equipment for prospective cruisers, as recommended by the Advisory Board, $760,000.

For equipment of U. S. S. New York, now on the stocks at the navy-yard, New York, $125,000.

For equipment of two vessels for the training squadron, to be composite clipper, bark-rigged sailing vessels, of 800 tons each, with auxiliary steam-power, $75,000.

Under appropriation "Coasters' Harbor Island" the Bureau asked for

$41,000 for the necessary improvements of this station for the current year, but Congress appropriated only $21,000, in consequence of which the Bureau was obliged to forego desirable improvements required for the training service.

In this connection the estimates are submitted for $60,000 for improvements at the training station, Coasters' Harbor Island, which improvements have been recommended by the commanding officer of that station as absolutely necessary, and which meet the Bureau's approval in every particular.

TRAINING SHIPS.

In order to properly educate the apprentices, under the training system, it is of prime importance and positive necessity that the cruising training ships should be vessels of the most modern type and construction, that the system may be kept abreast of and the apprentices be familiar with all the improvements in the man-of-war of the present day. The training-ships now in commission are in bad condition and require extensive and costly repairs. The time is not far distant when they will be entirely unseaworthy. In view of these facts the Bureau urgently recommends for your consideration the construction of the two composite sailing vessels, with auxiliary steam-power and lifting screws, as estimated for by the Bureau of Construction and Repair and for the equipment of which this Bureau has asked $75,000 under appropriation "Increase of the Navy." The Bureau is of opinion that the building of these vessels would be a wise and economic measure, and obviate the constant repair of the old and almost obsolete cruising training-ships.

COAL.

There have been purchased at home and abroad 56,624 tons of coal, costing, including freight and handling, $408,526.42.

ROPEWALK.

The following cordage has been manufactured during the past fiscal year at the ropewalk, navy-yard, Boston, Mass.:

	Pounds.
Russia and American hemp rope	233,154
Manila hemp rope	268,545
Wire rope	14,065
Hide rope	2,628
Total	518,392
Costing for materials	$53,505 72
Costing for labor	37,943 93
Total	91,449 65

HEMP.

There have been purchased—

		Quantity.	Value.
Manila hemp	pounds	292,557	$33,491 88
American hemp	tons	$7\frac{1428}{2240}$	1,645 13
Russia hemp	do	76	15,018 58
Total			50,155 59

FORGE AND ANCHOR, SMITH, AND CHAIN SHOPS AND ROLLING-MILL AT THE NAVY-YARD, WASHINGTON, D. C.

There have been manufactured in these shops during the past fiscal year—

Chain cable of various sizes	fathoms..	2,025
Forging, of iron and steel	pounds..	23,196
Iron cable links	do....	97,705
Steel cable links	do....	7,677
Bar iron	do....	145,040
Plate iron	do....	9,140
Hammered iron	do....	1,670

The Bureau intends to substitute steel for iron chains, if the report of tests now being made on board the Vandalia with some sample steel chain should warrant the adoption of the same.

GALLEY SHOP.

Eight new galleys have been manufactured, including cooking utensils, and extensive repairs have been made on 19 old galleys belonging to various vessels in commission.

SAIL LOFT, WASHINGTON NAVY-YARD.

There have been made, for the vessels requiring them, 84 new sails, besides awnings, hammocks, hammock cloths, clothes bags, and other miscellaneous sailwork.

ENLISTED MEN.

On the 30th June, 1884, there were in the Navy 8,947 men and apprentices, a small temporary excess of the total number allowed by law, and which occurred from unavoidable detention of one or two vessels in their arrival home from foreign stations. During the greater part of the year the number of men has been under the legal quota. The average number has not exceeded the statutory allowance.

The Bureau reiterates the recommendation of previous reports, and again submits that special legislation should be made for enlisting men for the Coast Survey, Fish Commission, and Naval Academy. The increasing demands of these establishments draw largely from the quota allowed at present for the Navy and cause much embarrassment. The small force remaining is not sufficient to properly man the regular cruising vessels. I would suggest that the force for these services be limited to 500 men, and be known as "auxiliaries for special service."

In connection with the enlistment of men, the Bureau strongly recommends that legislation be enacted with a view to allow men honorably discharged from the service to elect a home on any receiving ship for a period not exceeding three months from the date of their discharge; men so electing a home to be entitled to one ration per day to feed them while on board, and to be amenable to such regulations as the Bureau may establish while so residing. Such legislation would be conducive to the comfort and morals of the men, whose only homes are the vessels of the Navy. The service would be much benefited in the improved character of the *personnel*. The men would be able to escape much discomfort now experienced in the larger cities, where many of them are driven by necessity, after their discharge, into miserable and uncleanly boarding places.

In the interest of the seamen and marines of the Navy I would urgently request that section 2166 of the Revised Statutes, referring to

aliens in the Army becoming citizens, be amended to include the Navy and Marine Corps.

I would also recommend that sections 4756 and 4759, Revised Statutes, be so amended as to apply to men who have served in the Navy as appointed petty officers.

APPRENTICES.

During the year there were 3,596 boys examined for enlistment as apprentices for the training service, of which number 2,120, or about 59 per cent., were rejected on account of various physical disqualifications. Of those qualified, 582 were either unable to satisfy the recruiting officers as to their character and habits, or failed to complete their shipment, making the number actually enlisted 894, a trifle less than 25 per cent. of the applicants. Sixty-nine apprentices have been discharged by reason of the expiration of their enlistments, and 171 on account of physical disability, inaptitude for the service, misconduct, &c.

The cruising training-ships Portsmouth, Jamestown, and Saratoga have been kept at sea, on practice service, with different detachments of apprentices, except while undergoing the necessary repairs or preparation for such service, and during the year 208 apprentices have been transferred to the cruising ships of the Navy, in addition to which, at its close, there were 70 *en route* to the European station to join the U. S. S. Lancaster and Quinnebaug.

On the 30th June, 1884, there were 490 apprentices serving on general cruising vessels, distributed as follows:

North Atlantic Station	142
South Atlantic Station	34
Pacific Station	73
European Station	53
Asiatic Station	188

And also 682 on board of the stationary and cruising training-ships, preparing for the general service.

The Bureau recommends that application be made for such legislation as will authorize the enlistment of 1,000 boys annually, instead of 750, the number at present allowed.

The Bureau most earnestly urge that Congress be asked to appropriate a sufficient sum of money to provide every man, boy, and *apprentice*, on enlistment in the Navy, with an outfit of clothing, the cost not to exceed $50, thereby placing a sailor on similar footing with the soldier or marine, who are now not only furnished with an outfit when enlisted, but receive an *annual* allowance at the public expense and without any charge to them. At present the clothing outfit of a recruit for the *Navy* costs nearly, and sometimes quite, three months' pay, which he assumes as a debt to the Government; and in many instances the clothes are worn out before they are really paid for; and while such indebtedness exists the enlisted man of the Navy enjoys no privilege of liberty, nor can he draw any money for his own personal use. Naturally this system is regarded by sailors as oppressive, and tends to discouragement, and is often followed by desertion, with theft of outfit; and it is believed that if the enlisted persons of the Navy were placed upon a similar footing with those of the Army and Marine Corps, desertions would be less frequent and the *personnel* of the service would be very much improved.

Very respectfully, your obedient servant,

W. S. SCHLEY,
Chief of Bureau.

Hon. W. E. CHANDLER,
Secretary of the Navy, Washington, D. C.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Equipment and Recruiting, Navy Department.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1885.
EQUIPMENT OF VESSELS.		
Coal for steamers' and ships' use, including expenses for transportation, storage, and handling; hemp, wire, hides, and other materials for the manufacture of rope and cordage; iron for the manufacture of anchors, cables, galleys, and chains; canvas for the manufacture of sails, awnings, bags, and hammocks; heating apparatus for receiving ships; and for the purchase of all other articles of equipment at home and abroad, and for the pay of labor in equipping vessels, and manufacture of equipment articles in the several navy-yards (appropriated R. S., p. 733, secs. 3709, 3747)	$896,000 00	$400,000 00
TRANSPORTATION AND RECRUITING.		
Expenses of recruiting for the naval service, rent of rendezvous, and expenses of maintaining the same, advertising for men and boys, and for the transportation of enlisted men at home and abroad (appropriated, R. S., p. 721, sec. 3666)	35,000 00	12,500 00
CONTINGENT BUREAU.		
Extra expenses of training ships, freight and transportation of equipment stores, printing, advertising, telegraphing, books and models, postage, car tickets, ferriage, ice, apprehension of deserters and stragglers, certificates and good-conduct badges for enlisted men, school books for training ships, medals for boys, and emergencies arising under the cognizance of the Bureau of Equipment and Recruiting, unforeseen and impossible to classify (R. S., p. 721, sec. 3666)	20,000 00	5,000 00
CIVIL ESTABLISHMENT.		
Navy-yard, Kittery, Me.:		
One clerk	1,300 00	
Navy-yard, Charlestown, Mass.:		
One superintendent of ropewalk	1,800 00	
One clerk	1,400 00	
One clerk	1,300 00	
One writer	1,017 25	
Navy-yard, Brooklyn, N. Y.:		
One clerk	1,400 00	
One clerk	1,300 00	
Navy-yard, League Island:		
One clerk	1,300 00	
Navy-yard, Washington, D. C.:		
One clerk	1,400 00	
One clerk	1,300 00	
One writer	1,017 25	
Navy-yard, Norfolk, Va.:		
One clerk	1,300 00	
Navy-yard, Pensacola, Fla.:		
One writer	1,017 25	
Navy-yard, Mare Island, Cal.:		
One clerk	1,400 00	
	18,251 75	4,500 00
SALARIES.		
Chief clerk (increase of $450 submitted), (July 7, 1884, R. S., p. 70, sec. 415	2,250 00	
NOTE.—The chief clerk is required by law to act as chief of Bureau in case of vacancy or of the absence or sickness of that officer (in case no other appointment is made). His duties are as responsible and arduous as those of the chief clerks in the other Executive Departments, who are required by law to perform the same functions, and who now receive a like compensation, viz, $2,250 per annum.		
One clerk of class 4 (July 7, 1884, R. S., p. 70, sec. 416)	1,800 00	
One clerk of class 3 (July 7, 1884, R. S., p. 27, sec. 167)	1,600 00	
Two clerks of class 2 (same acts)	2,800 00	
Three clerks of class 1 (same acts)	3,600 00	
Two copyists (same acts)	1,800 00	
One assistant messenger (same acts)	720 00	
One laborer (same acts)	660 00	
	15,230 00	14,780 00

Estimates of appropriations required for the service of the fiscal year, &c.—Continued.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1885.
INCREASE OF THE NAVY.		
Amount required to furnish complete equipment outfit for the following new vessels, viz:		
One cruiser of 4,500 tons (submitted)	$125,000 00	
One cruiser of 3,000 tons (submitted)	100,000 00	
One dispatch boat of 1,500 tons (submitted)	60,000 00	
Two heavily armed gunboats of 1,500 tons each (submitted)	120,000 00	
One light gunboat of 750 tons (submitted)	45,000 00	
One gunboat of 900 tons (submitted)	50,000 00	
One steel ram (submitted)	15,000 00	
One cruising torpedo-boat (submitted)	25,000 00	
Two harbor torpedo-boats (submitted)	20,000 00	
One armored vessel of 8,500 tons (submitted)	200,000 00	
For equipment outfit of the New York, on the stocks at navy-yard New York (submitted)	125,000 00	
	885,000 00	....
For equipment outfit of two composite clipper bark-rigged sailing vessels of 800 tons each, with auxiliary steam power, for the training squadron (submitted)	75,000 00	....
NAVAL TRAINING STATION, COASTERS' HARBOR ISLAND.		
For completing wharf	15,000 00	
Bath and drying house	5,000 00	
Repairs to main causeway, including enlargement of tideway and bridge to span the opening (submitted)	8,000 00	
New boat-house and carpenter-shop	6,000 00	
Wharf crane	3,000 00	
Dredging, maintenance, and repair of sea-wall, roads, and grounds, and the necessary labor and implements required for the proper preservation of the same	23,000 00	
	60,000 00	

No. 6.—BUREAU OF NAVIGATION.

NAVY DEPARTMENT, BUREAU OF NAVIGATION,
November 1, 1884.

SIR: I have the honor to submit the following report of the Bureau of Navigation for the past year, together with the estimates for its support, and for the expenditures that will be necessary for the fiscal y ending June 30, 1886.

Included in this report and transmitted herewith are the reports estimates of the several offices under its control.

NAVIGATION.

Compasses.—During the past year 145 compasses of different t have been repaired, inspected, and tested, the four-needle card whi was adopted last year being used in all of them. These compasses have been issued to ships, and have given general satisfaction. The Greely Relief Expedition of 1884 was supplied with the improved compass and their behavior in high latitudes has been much commended. reports of the expedition contain a quantity of valuable matter re ive to the variation of the compass in latitudes where few opportuniti on for such observations. This expedition was also supplied with dip-circles, magnetometers, and the necessary books, instructions, and blank forms, but its successful early termination prevented observations for magnetic force and dip.

The work of collecting data relative to the variation of the compass has been successfully continued during the year, the results of which are in course of preparation for publication.

The deviation of the compass in iron and steel ships has received the most careful attention, and Professional Paper No. 17, "The Magnetism of Iron and Steel Ships," has been prepared and is now in press. Professional Paper No. 18, on the deviations of the compass in vessels of the United States Navy, is nearly ready.

Preparations have been made for a careful examination of the magnetic character of the new steel vessels, and a compass station will be established in Narragansett Bay, in the vicinity of the "measured mile." In view of the probable necessity of compensating the compasses of these vessels, a binnacle for the purpose has been designed in the Bureau, and will be placed in the Dolphin for test.

The instruments for a compass-testing house are in possession of the Bureau, and an appropriation for the erection of a building passed both Houses of Congress during the last session, but is not available in consequence of the failure of the naval appropriation bill to become a law and the substitution therefor of an act "making temporary provision for the naval service."

A marked improvement has been apparent during the past year in both the character and number of the compass reports received from

vessels in commission. Besides fulfilling their primary object of contributing to safe navigation, these compass reports afford explicit information regarding the variation of the compass in different localities.

Determination of longitudes.—The work of establishing secondary meridians of longitude on the west coast of Central and South America by means of the submarine cable has been completed.

A party of naval officers under Lieut. Commander C. H. Davis sailed from New York on the 20th of September, 1883, established stations at various points between La Libertad, San Salvador, and Valparaiso, Chili, and measured the differences of longitude between Valparaiso, Arica, Lima, Payta, Panama, and La Libertad. Measurements between La Libertad and Guatemala were made in co-operation with Mr. Miles Rock, of the Guatemala survey. From Valparaiso signals were exchanged upon several nights with Dr. B. A. Gould, director of the national observatory at Cordova, Argentine Republic, for the purpose of connecting the measurements made on the west coast of Central and South America with those made on the east coast of South America by naval officers under the direction of this Bureau in 1878 and 1879. The party returned to the United States in April last, and the observations are now being reduced and prepared for publication.

Navigation Supplies.—The electric plant for incandescent lighting supplied to the Trenton, beyond some slight defects in the insulation of the wires, which could not have been anticipated, has given great satisfaction, and has added materially to the comfort and health of the officers and crew.

The Atlanta, Boston, and Omaha are to be lighted by electricity. The plant for the Atlanta is to be supplied by the United States Electric Lighting Company of New York, that for the Boston by the Brush Electric Company of Cleveland, and that for the Omaha by the Consolidated Electric Light Company of New York. In these vessels the defects referred to in the wiring of the Trenton will be remedied.

Additional information has been supplied for the libraries of the cruising ships, and I would again call attention to the importance of supplying, in convenient form, such professional matter as is essential to naval officers, and of value to the merchant marine and the ship-building interests, but which cannot now be published because of the inadequate appropriation for printing.

Department Library.—During the past year the work of classifying and cataloguing the books in the library has been continued, and important additions have been made to the collection. In order to put the library on a proper footing and to meet the requirements of the Department in the various branches of modern professional investigation, an increase in the annual appropriation is required, and an estimate therefor has accordingly been submitted.

Under existing law, no binding can be done for any Department of the Government except in plain sheep or cloth. Exceptions to this rule have been made in favor of the Congressional Library and the libraries of the Department of State, the Patent Office, and the Office of the Surgeon-General of the Army. The restriction upon the character of the binding for other Department libraries is harmful to the interests of the Government by making it impossible to keep sets of volumes in a uniform binding, while the saving in expense is so small as to be wholly out of proportion to the resulting disadvantages; and it is clear that the reasons which exist for the exceptions in favor of the libraries of the Department of State, the Patent Office, and the Surgeon-General's Office apply with equal force to those of the other Executive Departments.

Regulations for preventing collisions at sea.—The act entitled "A1 to adopt the Revised International Regulations for preventing col at sea," which passed the House of Representatives at the last of Congress, and which has been reported in the Senate, will, u n comes a law, do away with the confusion which has existed in quence of the difference between the laws of the United States and regulations adopted by other maritime nations, and will tend to preve collisions which are now likely to occur because of the delay in a ing such international regulations.

In this connection I desire to renew my recommendation to so am rules 17 and 20, of section 4233 of the Revised Statutes of the Uni States, as to give deep-draught ships the right of way in deep and r row channels in localities where light-draught vessels will not be l to injury by using shoaler water.

HYDROGRAPHIC OFFICE.

The work of the Hydrographic Office has been confined to correcting the copper plates on hand, to the production of new charts from veys by officers of the Navy, and to the preparation and publication nautical information. The importance of additional surveys by t Government has been repeatedly urged by this Bureau, and I renew the recommendation contained in my annual reports for the past two years, that new surveys be made of portions of the north coast of South America and of the coast of the island of San Domingo. The charts of these localities are imperfect and incorrect, and until new surveys and examinations are made their use tends to increase the number of annual shipwrecks and the consequent loss of life and property. To make such surveys and examinations vessels especially adapted for surveying are more economical than vessels of war. The steam whalers Thetis and Bear, purchased for the Greely Relief Expedition of 1884, would answer the purpose admirably, but a clause in the act appropriating for this expedition requires them to be sold. I would suggest, both in the interest of economy and efficiency, that this clause be repealed and these two ships be retained in the naval service for surveying purposes.

The hydrographic work of the geodetic and hydrographic survey of the Sandwich Islands, now being carried on by the Hawaiian Government, extends off shore to the 100-fathom line, and it is recommended that this Government shall continue the work by running lines of deep-sea soundings for the purpose of determining whether the innumerable dangers which are now reported in the Pacific Ocean do or do not exist.

To facilitate the operation of the Hydrographic Office in giving information to the merchant marine and to others interested in nautical matters, branch offices have been established in the cities of Boston, New York, Philadelphia, Baltimore, New Orleans, and San Francisco. These offices, through the liberality of the maritime exchanges in the several cities, are located in the rooms occupied by these organizations. They are in charge of naval officers, and are supplied with charts, nautical works, lists of lights, and sailing directions corrected to date.

In continuation of the scheme proposed and begun by the late Lieutenant Maury, the first edition of the monthly Pilot Chart of the North Atlantic Ocean was issued December 1, 1883. The increased demand for these charts, which have been published regularly since that date, and issued on the first of each month, is conclusive proof of the necessity for, and value of, the publication.

The survey of the west coast of Central America has been completed as far south as San Juan del Sur, Nicaragua, by Commander Clark and the officers of the Ranger, and plates of the work are being engraved. The survey is now being continued south and east of the point above mentioned.

Professor Baird having placed the Fish Commission steamer Albatross at the disposal of the Navy Department during the winter months of 1883–'84, she was employed to examine the bottom of portions of the Caribbean Sea, the depths of which are unknown. In sounding across that sea a shoal was developed off the eastern end of Jamaica, to which the name Albatross Bank has been given. In addition to this work, which was highly successful and creditable to the officers of the Albatross, the exact position of San Antonio light, western end of the island of Cuba, was established, and the reported dangers off that point were proved not to exist.

The officers of the vessels in commission have contributed much valuable hydrographic information, which has been issued in the form of "Notices to Mariners," or utilized in the Hydrographic Office.

In this connection I desire to state that nautical men generally favor the adoption of a universal system of marks and buoys for channels and approaches to harbors. There can be no valid objection to adopting one general system in place of the many which now prevail, as the cost of such changes as might become necessary, were an International Congress to recommend a system, would be little more than that of the paint necessary for changing the color of buoys and marks.

NAVAL OBSERVATORY.

The report of the Superintendent of the Naval Observatory contains the details of the work performed with the several large instruments, of the transmission of time signals, of the introduction and adoption of a system for regulating the time in the several Executive Departments by controlling the clocks in the various offices from the Naval Observatory, and of the reduction of the various observations of the transit of Venus of 1882.

The appropriation for printing and binding is insufficient, and in consequence the results of the work of the Observatory cannot be published for the use of the public.

The necessity for an appropriation with which to begin the buildings for the new Naval Observatory upon the site selected by a commission appointed for the purpose and purchased by the Government, so often mentioned in previous reports, is more apparent than ever, in consequence of the dilapidated condition of the buildings and the unhealthy and improper location of the present Observatory, and I again urge the importance of an appropriation for that purpose.

NAUTICAL ALMANAC.

The report of the Superintendent shows that the work in preparing the annual volumes of the Nautical Almanac and Ephemeris for 1888 is well advanced, and gives a list of the papers which have been published in Astronomical Researches, supplementary to the Ephemeris.

The second volume of the "Atlantic Coaster's Nautical Almanac," that for 1885, has been issued, and the first volume of a "Pacific Coaster's Nautical Almanac" has been prepared and is now in press.

The computations and discussions of the observations and experiments for determining the velocity of light have been completed, and are being prepared for publication.

ESTIMATES.

I beg to invite your attention to the annual appropriations for this Bureau, which have steadily decreased in amount from $192,500 for the fiscal year of 1866–'67, to $100,000 for the year 1883–'84. Since the year 1866 the amount appropriated annually to carry on the work under the cognizance of this Bureau has been insufficient to supply our vessels with the best and most improved articles of navigation outfit. In consequence, however, of the quantity of supplies purchased during the civil war and remaining on hand at its close, cruising ships have been furnished with instruments for navigating, which, if not of the latest patterns, still answered the purpose for which they were purchased in the absence of better. But the supplies above mentioned have gradually been exhausted, or have become obsolete and have been sold as "unserviceable" in compliance with the act of Congress approved August 5, 1882, which required all stores and supplies to be appraised, and those found to be unserviceable to be sold.

I have submitted an estimate for $130,000 under the head of "Navigation and navigation supplies," the amount, in my opinion, being necessary to properly administer the Bureau by providing the best and safest apparatus for navigating, better appliances for lighting ships, and the necessary professional information, without which it cannot be expected that the officers and men of the Navy will keep pace with the changes which are constantly taking place.

Very respectfully, your obedient servant,

J. G. WALKER,
Chief of Bureau.

Hon. W. E. CHANDLER,
Secretary of the Navy.

UNITED STATES HYDROGRAPHIC OFFICE,
Washington, D. C., October 20, 1884.

SIR: As directed by the Bureau, I have the honor to submit the following report of the operations of this Office for the fiscal year ending June 30, 1884, and to make such recommendations for increasing its usefulness as have been suggested by the experience of the past year.

DRAUGHTING AND ENGRAVING DIVISION.

The draughtsmen of this Division have been engaged in preparing for the engravers the surveys made by the Ranger on the west coast of Mexico; in drawing general sailing charts of the Atlantic Ocean and waters adjacent to the American continent; in compiling maps of the Arctic for the Greely Relief Board, and others for the Department; and in revising the charts already issued.

The information received from various sources, including foreign hydrographic offices, renders it necessary to keep a large force constantly employed in correcting these charts to date. The engravers have completed the chart of Samana Bay, mentioned in the report of last year, and have been constantly engaged in correcting the copper-plates of the charts already on issue, resulting from the continual revision of the

manuscripts by the draughtsmen. The several plates in hands of outside engravers at the close of the last fiscal year are still unfinished, but will be completed in a few months.

It is proposed to make numerous changes in the methods in use in this Division, and, by systematizing the work as completely as possible, to employ the force more advantageously and economically. A scheme of charging all information as soon as it comes in against each chart affected will give a complete history of it at all times and facilitate the collection of data whenever it becomes necessary to revise it. By this plan each chart keeps an open account with all sources of information, as well as with the draughtsmen and engravers who work upon it.

A radical change is proposed in the compass, the degree graduations being given on a true compass. It would be well also to put much of the information which is now on the body of the chart in a tabulated form, so as to add to its clearness and facilitate its correction. Standards for borders, titles, and styles, size and arrangement of lettering will be adopted. In giving out contracts to engravers they will be obliged to make all work conform exactly to a system of topography, lettering and borders to be adopted, thus leaving nothing to individual tastes, which always causes undesirable variety.

PLATE AND PRINTING DIVISION.

The work of this Division has been materially increased by the greater demand for charts, 16,910 copies having been printed as against 12,180 of the preceding year, showing an increase of 39 per cent. A careful study has been made of the latest improvements in copper-plate printing in the various Government offices and in private establishments. Every advantage has been taken by this Division to bring its work up to the highest standards, both as regards the use of ink and the most skillful manipulation of the plates. In accordance with my recommendation the work of electrotyping the copper-plates has been commenced, and will be continued. At the close of the year 23 altos and 9 bassos had been completed.

CHART DIVISION.

The force of this Division has been constantly employed in keeping the supply of charts corrected to date by hand. When changes are extensive the issue is temporarily suspended and the chart revised by the Division of Draughting and Engraving. Every ship of war, all agents, and all correspondents have been supplied with new copies whenever any important corrections have been made, and no chart has been sent from this office that has not embodied the very latest information to be obtained. This Division has also made an examination into the authenticity of reported dangers, and has computed distances required by the Bureau for the Fourth Auditor of the Treasury.

In the performance of its functions of filling all orders this division has issued charts to the following:

Ships of war	5,941
Merchant vessels, transmitting meteorological journals	1,570
Home correspondents and libraries	574
Foreign hydrographic offices	537
Agents, for sale	8,857
Branch hydrographic offices and other Government offices	7,886
Files of archives	814
Total	26,179

Four thousand three hundred and seventeen Coast and Geodetic vey charts were supplied to ships of war.

ADMIRALTY CHART DIVISION.

The policy suggested of buying new editions of British Admi charts as fast as they appear, and not attempting to correct old editi by hand, has been rigorously carried out. This has been further extended by ordering from London to the ships of war direct the new tion, as soon as it appears, of any chart that may be on the chart- the squadron to which the ship belongs. Thirty per cent. of the charts on all the naval vessels have been replaced in this manner, and I great satisfaction in stating that the ships are now kept supplied with the very latest hydrographic publications that the mails can get to th The supply on the shelves is also of the latest date, and is kept corrected by hand for such information as does not require a new edition.

As the number of British Admiralty charts necessary to supplement those published by this office is 2,300, it can be seen that the small force of this Division is heavily taxed. The number of copies of each chart on the supply shelves has been largely reduced, experience having shown it to be best to keep as few as possible. The practice of buying these charts through an intermediate agent in London was chang at the beginning of the fiscal year, and the purchases have since been made direct from the agent of the British Admiralty, making thereby a saving of 25 per cent.

In addition to the regular duties of this Division, new chart-lists for each squadron on a more practical and systematic plan have been compiled, and will be printed during the present fiscal year.

DIVISION OF BOOKS.

During the year the books in this department of the office have been thoroughly overhauled and rearranged. Many which had become valueless on account of the changes since their publication have been removed from the issuing list and their places filled by other works.

A study has been made of the most suitable kind of binding for sea books, and the propriety of adopting certain colors for the bindings to designate those belonging to different stations has also been under consideration. Precautions have been taken to preserve the books from the ravages of insects by wrapping them in thick paper.

The force of the Division has been mainly employed in compiling sailing directions of Newfoundland and Labrador, Vol. II of the Caribbean Sea and Gulf of Mexico, and in correcting all sailing directions and light-lists furnished to Government vessels to date of issue.

NOTICE AND ARCHIVE DIVISION.

The policy of republishing without delay in Notices to Mariners all information coming into the office has been carried out as far as possible with the limited facilities for printing controlled by the Office, and at the same time the field for collecting information has been extended by establishing exchanges with every office in the world having an interest in hydrographic work. The number of official correspondents, including hydrographic offices, light-house boards, colonial and port departments, has been increased to 56. From these, 2,400 printed notices

in ten different languages have been received, all of which have been translated by officers and republished. The edition of each Notice has been increased from 500 to 1,000 copies.

On January 1 the two publications known as Notices to Mariners and Hydrographic Notices were merged into one, called Notices to Mariners, and at the same time, after careful consideration, the system of showing true bearings in degrees was adopted, instead of magnetic bearings in points, as was previously the custom. Three hundred and eighty-seven Notices, containing 1,070 announcements, were issued during the year.

The light-lists compiled in this Division, numbering six volumes, and embracing the light-houses of the world, were corrected to July 1, sent to the printer, and mailed to the ships of war and to the agents for sale by the 20th of the month.

If these important aids to the navigator are to be of any use, such prompt action is always absolutely necessary, as the changes in lights in different parts of the world are so frequent and often so radical that editions should be issued annually, and when ready for printing should remain the shortest possible time in the hands of the printer.

METEOROLOGICAL DIVISION.

The work of this Division has included an extension of the number of observers of ocean meteorology, keeping track of old observers in the merchant marine, distributing blank journals, and examining and recording the data received from all sources. The set of new meteorological charts of the North Atlantic has been issued, and has been very favorably received. These charts present the principal meteorological phenomena of the ocean in a graphic form for each month of the year. The method is so comprehensible that a mere inspection shows what meteorological conditions the mariner may expect in each five degrees square of the ocean surface. The data for these charts have been deduced from over two million hours of observations, extending over a period of forty years. The compilation of a similar set for the South Atlantic has been commenced, and is well advanced.

The energy of this Division has been directed principally, however, to the publishing of a monthly chart embodying the plan set forth in my report of last year and issued under the title of Pilot Chart of the North Atlantic Ocean. The first edition of this publication appeared December 1, 1883, and the issue has been continued on the first of each month since. The reception of this graphic bulletin of what has occurred on the sea during the month past and what may reasonably be expected during the coming month has been most flattering. The demand for it among seafaring men has steadily increased as it has become more widely known, and the interest it has awakened among ship-masters is indicated by the fact that several have telegraphed from Europe, at their own expense, any interesting information they may have encountered during the voyage across. It is known that vessels have taken the safe route indicated during the prevalence of icebergs when they would otherwise have taken a more dangerous course. The publication of this chart has also facilitated the study of the limits of the trade winds, the general location of water-spouts, and will be the means of defining eventually the approximate limits of fogs off the coast of the United States and Banks of Newfoundland. The sailing routes laid down have been followed with satisfactory results.

BRANCH OFFICES.

The work of the branches already established in Boston, New York, and Philadelphia having proved of such immediate and substantial benefit to the maritime community, the exchanges of other cities very soon asked for similar establishments, and accordingly offices were opened in Baltimore on December 14, 1883, in San Francisco February 1, 1884, and in New Orleans May 19, 1884. These six branch offices have more than realized all that was expected, and the most gratifying assurances of their increasing value are continually received from all interested, either directly or indirectly, in the seafaring public.

To enumerate some of the advantages that have accrued to the merchant marine: It has been found, in response to the invitations to all ship captains to bring their charts for verification and correction, that many use old editions (in one instance fifty years old), which have been discontinued for years, and they have been surprised to find that new editions showing quite different hydrographic conditions have long since supplanted them.

The Notices to Mariners, which had failed to reach the class most interested, have been most thoroughly disseminated, and their usefulness demonstrated so that the demand for them has been greatly increased.

The Pilot Chart, through the same channel, has obtained a still wider circulation, and, being a graphic representation of interesting and important nautical matters, has secured attention from those who have not time usually to investigate the same subjects presented in another way.

The importance of a central office which gathers this information having been thus practically shown, as was expected, the voluntary contribution of information has been largely increased.

The interest of ship captains has been aroused under the stimulus of an immediate and practical acknowledgment of their work to make such examinations as they can of reported dangers of all kinds, of calling attention to inaccuracies in the charts, and of reporting immediately and definitely, and in such form as to be intelligible, all new matters relating to hydrography and cartography which come under their observation.

Many ship-masters go to the branch offices for information in regard to the prices of the publications of this office, and in numberless instances it has been found that they have been in the habit of paying more than the price authorized by the catalogue. This often deters them from buying late editions, to the manifest injury of their owners and to the prejudice of this Office. The doing away of this abuse has been an important factor in the increase of the sale of charts, which has been 57 per cent.; and through the same influence, acting in various ways, the general issue of charts has increased 116 per cent. The agents, who are in most instances the agents also of the Coast and Geodetic Survey, inform me that for similar reasons the sale of the Coast and Geodetic Survey publications has increased largely.

The collection of data for the study of the meteorology of the ocean has been facilitated in a remarkable degree. Many journals given out by this office that have long been lost sight of, as the masters frequently transfer them without notifying the office, have been traced and recovered, and valuable data, which have been withheld for a variety of reasons, have been secured. The officers, by explaining the practical value of observations and the common benefit that is sure to ensue, have induced many who were indifferent to contribute to this work. By careful com-

parisons or adjustment of instruments by means of the standards, with which all the offices are furnished, and a patient explanation of what is required, great interest has been aroused, and the distribution of blank meteorological journals to voluntary observers has increased 100 per cent., while the increase in the accuracy of the observations cannot be estimated.

The services of the officers have been called into use to determine all kinds of questions of a nautical nature by all branches of the community, and the presence of professional men always ready to investigate any subject relating to the different departments of this Office has been of great value to marine insurance companies, shipping agents, admiralty lawyers, and, in fact, to every branch of business connected either directly or indirectly with maritime affairs. The number of vessels boarded by the officers attached to the branch offices during the year is 4,256; barometers corrected or compared, 2,062; abstracts of logs made, 873; wrecks reported, 1,171; ice reported by 242 vessels, and information given to 2,286 different individuals.

GENERAL RECOMMENDATIONS.

As set forth in my report of last year, the primary work of this Office should be the publication of the results of original surveys by American officers. The vessels of the Navy when visiting unfrequented ports, or those which are imperfectly surveyed, could render most important service by sending their boats to run lines of soundings, and the officers could determine the positions of prominent points by astronomical observations, and fix the contour of the shore line. It is believed that this could be done frequently without interfering with the routine of a ship of war. Continuous surveying, however, should be done by vessels fitted for the purpose, and a few small steamers or schooners should be placed at the disposal of this Office to enable it to do its share of the hydrographic service demanded by the shipping interests of the country.

The only vessel engaged making surveys during the year was the Ranger, on the west coast of Mexico and Central America. The work done there, which extended from the Gulf of Fonseca to San Juan del Sur, has fully justified the outlay, and it is hoped that she will be kept in service indefinitely as a surveying vessel.

I cannot advocate too emphatically the necessity of this Government taking a share of the general hydrographic work of the world commensurate with its maritime interests and importance. Charts are issued continually which from the nature of their origin are known to be only indifferent approximations to what should be represented.

A very good hydrographic reconnaisance can be made in a short time at comparatively slight expense, and, when the danger to life and property is considered, there seems to be no excuse why parts of the earth visited by our merchant marine, or in the general track of trading-vessels, should be left in their present doubtful condition as regards hydrography.

The recommendation of previous hydrographers with r[illegible]rd to a survey of the Caroline and Marshall grou[illegible] in the Pacific [illegible] [illegible]estly renewed. The consul of the United S[illegible]es at H[illegible] [illegible] date of July 21, 1884, reports to the Departm[illegible]nt [illegible] the American ship Rainier on the Marshall I[illegible] [illegible]s, and urges that a survey be made of the [illegible] Islands." This has been repeat[illegible]ly [illegible] Office, and when the position of [illegible]

they do in the trade-wind and westerly-current belt of the North Pacific, the natural highway of vessels bound to Japan, China, the Philippines, and the East Indies, the conviction as to what should be done becomes irresistible. In the North Pacific alone there are more than 3,000 reported dangers which do not exist or are incorrectly located. In many cases the same island has a half dozen different positions assigned to it by as many authorities, the maximum difference often amounting to 50 miles. This is a source of continual uncertainty to mariners in these waters which ought to be eliminated, now that the science of deep-sea sounding is so well developed. So little time is necessary to sound in great depths that an examination of any locality where a danger is supposed to exist could be very quickly made and the contour of the bed of the ocean absolutely determined.

Every vessel of the Navy should be provided with an apparatus and be required to sound wherever the charts show no depths, at distances of at least 20 miles. The method of examination by posting a lookout aloft while the vessel is in the vicinity of a danger is no longer of sufficient value to be accepted as final.

The Hawaiian Government is carrying on a hydrographic survey, to extend to a depth of 100 fathoms. The Government of the United States should continue the soundings to the other principal groups of the Pacific. It is suggested that the vessels of the Asiatic squadron now provided with sounding machines be required to use them when making passages from port to port, at distances of at least 20 miles apart.

My recommendations of last year with regard to new surveys of the north coast of South America and the West Indies are most urgently renewed. Our commercial interests absolutely demand better charts of this general locality. A vessel should be sent to the Spanish Main this winter to collect data for the revision of the charts of that region, which are mostly based on old Spanish surveys dating back to 1794. The coast of South America, eastward of Trinidad, and the outlying islands should also be examined immediately, and I recommend that a vessel be sent there this winter to commence the work.

Watson's Rock, lying in latitude 40° 17′ north, longitude 53° 22′ west, in the path of North Atlantic traders, has been reported so many times that its existence ought to be settled definitely. A ship provided with a deep-sea apparatus should be sent next summer to sound out this locality and to develop the submarine mountain ridge that probably exists between the Azores and the Flemish Cap, as indicated by Milne Bank, and the numerous reported dangers lying between the two extremes.

The United States Fish Commission steamer Albatross, with a party composed entirely of naval officers, was placed at the disposal of the Bureau for the winter months, and this Office suggested a general plan of work, which was very skillfully and satisfactorily carried out.

During the cruise of the Challenger it was demonstrated that in submarine lakes the temperature is constant to the greatest depth, and the same as that of the ocean at the depth of the rim of the lake.

The investigations of the temperatures of the Gulf of Mexico by officers of the Navy had shown that below a depth of 800 fathoms the temperature is constant at 39½°, that being the normal temperature of the ocean at that depth in the region of the equatorial current. The conclusion was, therefore, that no lower temperature than 39½° could be found in the Caribbean Sea, and consequently the passages into this sea could nowhere be deeper than 800 fathoms.

Another party of naval officers, during the years 1879 and 1880, in the

Coast Survey steamer Blake, sounded out the passages into the Caribbean Sea, and, with one exception, discovered no greater depth on the ridge than 800 fathoms. This depth was found in one place only—the Windward Passage. The exception noted was a narrow gully of 1,100 fathoms, with a bottom temperature of 38°, leading into a basin of 2,740 fathoms between St. Thomas and St. Croix. As the temperature at 1,500 fathoms just south of Mona Passage was 39½°, there could be no doubt of the existence of a rim from St. Croix to Puerto Rico. The Albatross, therefore, was directed to examine this locality, and found, as was expected, the ridge, with 900 fathoms on it at the greatest depth, and a least temperature of 39½°. This work, so eminently within the province of the Navy and performed with so much success by the naval officers, should be continued, and I recommend that a ship be fitted out expressly to make investigations into ocean temperatures at all depths, and thus obtain data necessary to determine the actual circulation of the ocean.

The Albatross also carried several lines of soundings across the Caribbean Sea, and developed very thoroughly the contour of the bottom, besides determining the non-existence of several reported dangers. A reported shoal about 25 miles east of Jamaica was examined, and the soundings indicated quite an extensive bank, having from 17 to 20 fathoms on it. This has been called Albatross Bank. An examination was made of the harbor of Savanilla, and a new chart of this port, which is becoming an important trading point for American commerce, is now being prepared.

The position of Cape San Antonio, which has long been in doubt, was fixed by careful observations, and a number of soundings off this cape verified the report of the Tallapoosa that the dangers at that point do not exist. The work of this ship cannot be too highly commended, and the Bureau is congratulated on having secured so much important information.

Some advance has been made in the investigation of wave motion, and the study will be continued. A circular giving a detailed statement of what is required will be issued shortly, and it is recommended that the observers on the vessels of the Navy be required to give greater attention to this important subject.

In conclusion, I wish to call the attention of the Bureau to the zeal and intelligence of the officers attached to this Office and its branches. The former have shown at all times the liveliest interest in the work, and have been of the greatest assistance in the arduous labor of reorganization which has been going on during the year.

The establishment of the branch offices has, of necessity, been left very much to the officers sent to them. They have done well in all cases, and I cannot commend their services too heartily.

The thanks of the office are due particularly to the State Department, the Coast and Geodetic Survey, the Light-House Board, the Fish Commission, and all foreign hydrographic offices.

The maritime exchanges of the seaboard cities where the branches are located have rendered special assistance, and the newspapers of the coast have been uniformly kind in spreading the information sent out by this Office.

Very respectfully, your obedient servant,

J. R. BARTLETT,
Commander, U. S. Navy, in charge Hydrographic Office.

Commodore J. G. WALKER, U. S. N.,
Chief of Bureau of Navigation.

APPENDIX.

SPECIAL INFORMATION FROM UNITED STATES NAVAL CRUISERS.

Various information of interest has been received and utilized by office from the following sources:

Capt. A. W. Weaver, U. S. S. Brooklyn, on ports visited.
Capt. J. S. Skerrett, U. S. S. Richmond, on ports visited.
Capt. C. C. Carpenter, U. S. S. Hartford, on ports visited.
Capt. E. E. Potter, U. S. S. Lancaster, on ports visited.
Capt. C. S. Norton, U. S. S. Shenandoah, on ports visited.
Capt. A. P. Cooke, U. S. S. Lackawanna, on ports visited.
Capt. R. R. Wallace, U. S. S. Vandalia, on ports visited.
Commander A. V. Reed, U. S. S. Alliance, on ports visited and in charts and sailing directions of West Indies.
Commander A. T. Mahan, U. S. S. Wachusett, on ports visited.
Commander H. B. Seely, U. S. S. Nipsic, on ports visited and directi for Parana River.
Commander J. W. Philip, U. S. S. Ranger, on continuation of survey of the Mexican coast.
Commander J. F. McGlensey, U. S. S. Ossipee, on ports visited.
Commander F. J. Higginson, U. S. S. Monocacy, reports, charts, data, sailing directions, currents China Sea, and ports visited.
Commander W. R. Bridgman, U. S. S. Kearsarge, on ports visited.
Commander A. H. McCormick, U. S. S. Essex, on ports visited.
Commander A. S. Barker, U. S. S. Enterprise, deep-sea soundings Mozambique Channel and off Madagascar, and ports visited.
Commander C. S. Cotton, U. S. S. Monocacy, charts, data, and sailing directions Salee River, Corea.
Commander P. H. Cooper, U. S. S. Swatara, on ports visited.
Commander Frank Wildes, U. S. S. Yantic, on ports visited, and notes on navigation of coast of Greenland.
Commander J. H. Sands, U. S. S. Iroquois, on ports visited.
Commander P. F. Harrington, U. S. S. Juniata, reconnaissance of Sunda Strait.
Commander N. Ludlow, U. S. S. Quinnebaug, on ports visited.
Commander C. E. Clark, U. S. S. Ranger, continuation of survey of the Mexican coast.
Commander J. B. Coghlan, U. S. S. Adams, hydrographic reports on Alaskan waters, channels, harbors, and islands.
Commander C. V. Gridley, U. S. S. Jamestown, on ports visited.
Lieut. Commander A. G. Caldwell, U. S. S. Pinta, on ports visited and Magellan Strait.
Lieut. Commander H. E. Nichols, Coast Survey steamer Hassler, hydrographic reports on Alaskan waters.
Lieut. Commander Z. L. Tanner, U. S. Fish Commission steamer Albatross, deep-sea soundings, serial temperatures, specific gravity of sea-water, observations for variation, currents, &c., North Atlantic.

LOG-BOOKS RECEIVED FROM MERCHANT VESSELS.

Log-books furnished by this office have been received during the year from the following-named captains of the merchant marine:

Capt. Benjamin Thompson, American ship Great Admiral.
Capt. A. H. Dunbar, American ship Grecian.
Capt. C. H. Norris, American ship Titan.
Capt. A. Campbell, British steamship Ethiopia.
Capt. W. E. Douglass, American ship St. Stephen.

Capt. Antonio Percich, Austrian bark Achille F.
Capt. A. Telfor, British ship Cashier.
Capt. Samuel Grierson, British bark Elizabeth Nicholson.
Capt. Henry J. Sleeper, American bark Addie E. Sleeper.
Capt. J. H. Sherman, American ship Raphael.
Capt. R. B. Brown, American ship Annie H. Smith.
Capt. N. B. Washburn, American bark Chasca.
Capt. E. H. Richardson, American bark Jos. A. Ropes.
Capt. Charles Hutchinson, American ship C. H. Marshall.
Capt. S. P. Bray, jr., American ship Panay.
Capt. W. C. Seabrook, British ship Lord Lytton.
Capt. J. S. Dillingham, American ship Vigilant.
Capt. E. V. Gates, American ship L. Schepp.
Capt. E. D. Lordly, American ship Minnie H. Gerow.
Capt. J. S. Lowell, American ship Geo. Stetson.
Capt. J. F. Bartlett, American ship Wm. H. Smith.
Capt. N. Dunbar, American ship Wm. McGilvray.
Capt. G. R. Morrison, American ship F. N. Thayer.
Capt. B. W. Chester, American ship Dauntless.
Capt. R. N. Williams, British bark Ocean.
Capt. Joseph Stokes, Belgian steamship Belgenland.
Capt. H. Webber, Belgian steamship Zealandia.
Capt. N. E. Reynolds, American bark Xenia.
Capt. D. H. Rivers, American ship Santa Clara.
Capt. J. C. Entwistle, American ship Sacramento
Capt. W. F. Ball, American ship Senator.
Capt. J. A. Bailey, American ship Southern Cross.
Capt. J. W. Strout, American ship Magellan.
Capt. A. M. Curtis, American ship Jas. Drummond.
Capt. G. L. Josselyn, American ship Mary L. Stone.
Capt. J. S. Cole, American bark Bonny Doon.
Capt. G. M. Buckman, American bark Itonus.
Capt. C. S. Dunning, American bark Fannie Skolfield.
Capt. R. F. Hardwicke, American bark Francis B. Fay.
Capt. G. W. Ginn, American bark Coryphene.
Capt. R. Gibson, British ship Coringa.
Capt. N. H. Townsend, British bark M. J. Foley.
Capt. E. W. McFadden, British bark Alpheus Marshall.
Capt. C. C. White, American bark Blanch How.
Capt. E. A. Marwick, American bark Rose Innes.
Capt. M. B. Cook, American bark St. James.
Capt. J. N. Colby, American bark H. G. Johnson.
Capt. R. K. Clarke, American ship Sea Witch.
Capt. E. L. Carter, American ship Armenia.
Capt. H. Fortman, German ship Otto.
Capt. A. Rich, American schooner F. N. Howes.
Capt. C. A. Johnson, American bark Edward May.
Capt. W. L. Johnson, American bark John B. Brewer.
Capt. B. Robbins, British ship Hectanooga.
Capt. T. P. Gibbons, American ship Jno. R. Kelly.
Capt. C. O. Carter, American ship E B. Sutton.
Capt. George Bissett, American schooner Beleatta.
Capt. G. E. Hawkins, American bark B. F. Watson.
Capt. G. L. Bray, American bark Wm. J. Rotch.
Capt. Leroy Dow, American bark Clarissa B. Carver.
Capt. M. L. Howes, American bark Freeman.
Capt. C. F. Harkness, American bark Wm. H. Macy.

Capt. B. A. Abbott, American bark Antoinette.
Capt. T. M. Davis, American bark Martha Davis.
Capt. D. Gould, American bark Nellie M. Slade.
Capt. O. Linnekin, American bark L. L. Sturgis.
Capt. C. F. Carver, American bark Hudson.
Capt. F. H. Purrington, American bark St. Charles.
Capt. H. Atwood, American bark Charles Stewart.
Capt. John S. Conant, American bark Jno. H. Clark.
Chief Officer F. Miller, British steamship Kirtle.

SPECIAL JOURNALS RECEIVED.

The following have filled special journals containing detailed account of storms encountered:

Chief Officer C. W. Muller, Danish steamship Thingvalla.
Chief Officer W. C. Brinkley, American steamship Lampasas.
Capt. Robert Leitch, British steamship City of Chicago.
Captain Vogelgesang, German ship Rhaetia.
Capt. Thomas Simmons, American brig The Charley.
Capt. George W. Kelly, American schooner Annie S. Merritt.
Capt. T. H. Gove, British steamship Brooklyn City.
Capt. T. C. Huggett, British steamship Lydian Monarch.
Capt. H. Schevensen, German steamship Hammonia.
Capt. John Harrison, British steamship Assyrian Monarch.
Capt. H. Hellmer, German steamship Habsburg.
Capt. William Stamper, British steamship Dorset.
Captain Hollander, German ship Von Roon.
Captain Dunstan, British steamship Amoor.
Capt. H. Barends, German steamship Silesia.
Capt. M. Murphy, British steamship Scythia.
Capt. Arthur Hyde, British steamship Richmond Hill.
Capt. James Peters, British steamship Gloucester.
Capt. E. C. Williams, British steamship Congo.
Capt. William Duncombe, British steamship Persian Monarch.
Capt. J. Watson, British steamship Egyptian Monarch.
Capt. J. W. Catherine, American steamship City of Savannah.
Capt. R. Munro, British steamship City of Rome.
Capt. W. Kuhlenein, German steamship Gellers.
Capt. B. Voss, German steamship Lessing.
Capt. C. Wiegand, German steamship Salier.
Capt. H. Barends, German steamship Westphalia.
Capt. James Isles, British bark Fleetwing.
Capt. L. Crowell, British steamship Roman.
Capt. J. Trenery, British steamship Oranmore.
Capt. F. Archer, British steamship Tower Hill.
Capt. Rogers, British steamship Helvetia.
Capt. Jones, British steamship Nubian.
Capt. D. Anderson, British steamship Coban.
Capt. Bristow, British steamship Grecian Monarch.
Capt. T. T. Holdt, German steamship India.
Capt. E. Weddall, British steamship Bracadaile.
Capt. Karlowa, German steamship Bohemia.
Capt. John Inch, British steamship Nessmore.
Capt. ——— ———, German steamship Main.
Capt. E. Nills, British steamship British Crown.
Capt. C. F. Burner, American brig Mary Fink.
Capt. George Geleson, British steamship Bellini.

Capt. H. Young, British steamship Devonia.
Capt. E. E. Wilson, British steamship Salerno.
Capt. W. A. Mallett, American steamship Alleghaney.
Capt. Samuel Owen, American steamship Irthington.
Capt. F. Warnecke, German ship Amelia.
Capt. John M. Getson, British bark Trueresk.
Capt. C. Habich, German steamship Wieland.
Captain Frangsel, French steamship Canada.
Capt. E. H. Freeth, British steamship British Princess.

J. R. BARTLETT,
Commander, U. S. Navy.

UNITED STATES NAVAL OBSERVATORY,
Washington, October 29, 1884.

SIR: In accordance with the Bureau's instructions, I have the honor to submit the report of the operation of this Observatory for the past year. I relieved Rear-Admiral Shufeldt as Superintendent on the 21st of February last. After having familiarized myself to some extent with the workings of the establishment, I became satisfied that its interests would be advanced by the organization of a Board consisting of the Superintendent, the senior professor of mathematics, and the senior line officer, whose duty it should be to meet from time to time and deliberate upon the conduct of the Observatory, and whose conclusions should form a basis of work to be done for each coming year. In conformity with these views, I issued the following general order:

GENERAL ORDER NO. 1.

The scope and character of the work to be done at the Naval Observatory shall be decided upon the recommendation of a Board to consist of the Superintendent, the senior professor, and the senior line officer.

Each officer in charge of a separate branch of work shall submit to the Superintendent annually—and more frequently if any changes be desired—a statement of the condition of the work under his charge and the work which he proposes for the coming year. These statements will be submitted to the Board by the Superintendent for their opinion and criticism, and upon the conclusions thus reached the work shall be based.

The Board shall be convened for consultation as often as the Superintendent may desire, or at the request of any member. The clerk of the Observatory will act as secretary of the Board.

The work will for the present be considered as divided in the following manner:

1. Great equatorial.
2. Transit circle.
3. Transit instrument.
4. Nine-inch equatorial.
5. Prime vertical.
6. Mural circle.
7. Time (including chronometers).
8. The library.

Each officer in charge of one of the above-named divisions will submit to the Superintendent before July 1 a detailed statement of the work proposed for the next six months, and hereafter a similar annual statement will be made on each 1st of January.

S. R. FRANKLIN,
Commodore, Superintendent.

NAVAL OBSERVATORY, *June* 18, 1884.

After the programme of work for the year commencing January 1, 1885, shall have been completed, I propose to have it printed and distributed amongst our correspondents, in order that other observatories, and those who are interested in the work of this one, may be thoroughly informed of what is done here, and also to prevent the unnecessary duplication of work which might be avoided by such information.

In order to systematize still further the working of the Observatory, I directed that reports should be handed to me every Monday morning by each officer in charge of a division, showing not only what had been done but how each person had been employed during the preceding week.

An effort has been made to establish at the Observatory a system by which all sextants and octants for issue to the Navy shall be examined and corrected, as far as practicable, and their errors, as well as those of instruments that are used for meteorological observations, be furnished to the navigators of vessels from this place, so that there would be a continuous record of every such instrument supplied by the Bureau of Navigation. I recommend that all such instruments as are found to be worthless be broken up, in order that they may be rendered incapable of doing harm to any one. As this work was discontinued when the officer in charge of it was detached, I respectfully recommend that some capable officer be ordered to the Observatory, to be assigned to this duty, who could, in addition thereto, be very usefully employed in photographing the sun each day at meridian, by which a record of the sun spots could be secured, and which, taken in connection with kindred observations at other observatories, would supply a mass of information upon this interesting and instructive subject which could not be otherwise than useful to all engaged in it.

I cannot too earnestly urge upon the Bureau the necessity of commencing the buildings for the new Observatory. The ground having been purchased and the plans made and approved, there seems to be no good reason why the construction should not begin. The present site is notoriously unhealthy, and the buildings are dilapidated and much in want of repair; and it would not be in the interest of economy to make any extensive repairs while the erection of new buildings is in contemplation. The delay is very prejudicial to this establishment in particular and to the cause of science in general. I respectfully request that if all the money cannot be appropriated for the purpose aforesaid at the coming session of Congress, a portion of it, at least, may be asked for, in order that this work, now so long delayed, may be begun.

I beg leave to reiterate the suggestion of my predecessor that there be appointed annually a Board of Visitors, to consist of a small number of scientific men, whose duty it should be to examine into the conduct of the Observatory, and make such suggestions as might add to its general usefulness. I think that by this means it would become better known and its work more highly appreciated.

THE 26-INCH EQUATORIAL.

This instrument has been in charge of Prof. A. Hall. Prof. S. J. Brown was assistant from October, 1883, to June, 1884. Lieut. W. H. Allen and Ensign J. A. Hoogewerff have rendered valuable assistance as computers. The instrument, the micrometer, and the driving-clock are in good order, and have been in constant use. For several years past the dome has been moved with difficulty. To obviate this a gas-engine of 4-horse power has recently been successfully connected with the turning machinery.

The work for the past year with this telescope consists of observations of the satellites of Neptune, Uranus, Saturn, and Mars, and of the observations of double stars. A few observations have been made for stellar parallax.

of Uranus the observations were confined mostly to the tellites, and it is proposed now to discontinue them, since e time for determining the position of the orbit planes of ites has passed. In the autumn of 1883 Professor Brown ng of Saturn and its rings.

trument, since it was mounted in 1873, has been largely rving the faint satellites of the planets, a great number rvations has been accumulated.

us work of discussing the observations, correcting the or- tellites, and determining the masses of the planets, was August, 1883; and, owing chiefly to the able assistance of Allen and Ensign Hoogewerff, good progress has been made. Brown also assisted in this work.

vations of the satellites of Saturn have nearly all been re- discussed, and equations of condition have been formed and t method of least squares. The final discussion of the re- adjustment of the weights remain to be done. This pre- is also nearly completed for the outer satellite of Uranus 1881, 1882, 1883, and 1884. It is proposed that this work all be steadily continued until all the observations made ument have been completely reduced and the final results

THE TRANSIT CIRCLE.

trument, in charge of Prof. J. R. Eastman, was employed on class of work as in 1882–'83. The assistants have been As- stronomers A. N. Skinner, H. M. Paul, and W. C. Winlock, V. M. Brown, jr., as computer. During the year ending Octo- 34, the whole number of observations with the transit circle Of these, 98 were of the sun, 84 of the moon, 151 of the nets, 45 of the minor planets, and 11 of comets.

teorological observations have been continued, as in former the watchmen.

THE 9.6-INCH EQUATORIAL.

rument, in charge of Commander W. T. Sampson. assisted gar Frisby, has been employed principally in observing the minor planets. There were made 134 observations of 406 of minor planets. All the observations have been re- o date, and most of them are ready for the printer. All occul- stars by the moon have also been observed.

THE PRIME VERTICAL INSTRUMENT.

ions with this instrument, which has remained in charge of r. Bowman, with Ensign Hiero Taylor as assistant, were main- il May, 1884, when some 1,020 observations had been taken. then discontinued, except that 13 observations of α. Lyræ in June and July, at the time of maximum parallax. During June both observers were employed in deducing clock cor- om the observations of the meridian transit, with whose side- the Howard clock, used in connection with the prime verti- en constantly compared. They also made with the level-trier

various observations to determine the value of a division of the level, and collected from all available catalogues data to deduce the mean places and proper motions of all stars used. It is proposed, however, to accept those already discussed by either Auwers or Boss, which will include some twenty of the stars observed, and to carry on the reductions, at first, of certain of the latter stars which have been most frequently observed.

Lieutenant Bowman having been transferred to the charge of the meridian transit instrument, the computations are being completed by Ensign Taylor.

THE MERIDIAN TRANSIT INSTRUMENT.

The meridian transit remained in charge of Lieut. U. R. Harris, who was assisted by Lieut. E. C. Pendleton until July last, when the former was detached, and the latter relieved Lieut. E. K. Moore of the charge of the chronometers and time service. Since that time Lieutenant Bowman has been in charge of the instrument, assisted by Lieut. John Garvin. The instrument has been used primarily to determine clock corrections in connection with the daily time service. In addition, special time signals have been sent out at the request of the Coast Survey, and observations for the right ascensions of the sun, moon, and major planets have been made. These latter have been reduced to the beginning of the calendar year.

The transit instrument is in good order, and the standard mean-time clock has performed very well. The sidereal clock has done very indifferently, but as chronographic comparisons are invariably made whenever observations are taken, no serious inconvenience has been caused.

THE MURAL CIRCLE.

This instrument is in charge of Prof. S. J. Brown. Mr. W. F. Gardner, the instrument-maker of the Observatory, during the summer put it in thorough condition, and Professor Brown is at present engaged in general instrumental adjustments, preparatory to making observations for declination upon certain stars, some 2,700 in number, a list of which has been prepared by him.

CHRONOMETERS AND TIME SERVICE.

This division is in charge of Lieut. E. C. Pendleton. There are at present in the chronometer-room 235 chronometers, of which 18 are ready for issue, 31 are on trial, 59 require repairs, and 127 are condemned to be used only as "hacks." Thirty-nine have been received from naval vessels and other sources, 6 were purchased after competitive trial, and 1 was received from William Bond & Son, in exchange for an old one of their make. Four pocket chronometers, 1 pocket half-chronometer, and 1 watch were also purchased after competitive trial. Sixty chronometers were issued to naval vessels and stations, 50 were sent to be cleaned and repaired, 55 were returned cleaned and repaired, and there are now 15 undergoing repair at the establishments of Messrs. Negus and Messrs. Bliss, in New York, and Messrs. Bond, in Boston.

Upon the adoption of what is known as "standard time," the following circular was issued:

DESCRIPTION OF TIME SIGNALS.

(*Seventy-fifth meridian, mean time.*)

[To be sent out by the United States Naval Observatory on and after November 18, 1883.]

The signals to be sent out by the Observatory are wholly automatic, and consist of a series of short *makes*, produced in an open telegraphic circuit by the beats of a mean-time clock, the pendulum closing the circuit at each beat.

The signals begin at 11 hours 56 minutes 45 seconds and cease at 12 hours, seventy-fifth meridian mean time. During that interval there is a *make* at the beginning of every second, except that in each minute the makes corresponding to the twenty-ninth second, and to the fifty-fifth, fifty-sixth, fifty-seventh, fifty-eighth, and fifty-ninth seconds, are omitted. Thus, the first make after the pause of five seconds always marks the beginning of a minute, and the first make after the pause of one second marks thirty seconds. In order to distinguish the last minute and give time to manipulate switches to time-balls, control-clocks, &c., the makes cease after 11 hours 59 minutes, 50 seconds and until 12 hours, when there is a single make, and the signals cease.

When these signals are received at points where the time of the ninetieth meridian is used, they will give the time from 10 hours 56 minutes 45 seconds to 11 hours, or just one hour earlier than when representing seventy-fifth meridian time; otherwise the signals will be read in the manner described above.

Seventy-fifth meridian time is 8 minutes 12.09 seconds earlier than Washington time.

UNITED STATES NAVAL OBSERVATORY,
November 10, 1883.

The transmitting clock of the Observatory was set to the seventy-fifth meridian time, and the time-signals given to the telegraph companies since that date have been in conformity with the above circular.

Owing to the increased demand for the time-signals, the Baltimore and Ohio Telegraph Company looped two of its main circuits into the Observatory, and the Signal Service looped one. The facilities of the Observatory for transmitting time-signals were very much extended, the apparatus being nearly all reconstructed and rearranged, and the signals are now transmitted from the Observatory over eleven wires. The District of Columbia authorities did not adopt standard time until March 1, 1884, and up to that date the Observatory ball was dropped at noon of Washington mean time, and the fire-alarm bells of the city were struck at 7 a. m., 12 m., and 6 p. m. of the same time. Since that date the ball has been dropped at noon of the seventy-fifth meridian, and the fire-bells struck at the same hours of seventy-fifth meridian time.

In March last the honorable Secretary of the Navy, at the request of the Superintendent, submitted to the heads of the several Departments the proposition to place in the more important offices of the Government, including the Executive Mansion and the Capitol, a clock that should be regulated and controlled every day from the Observatory, which establishment should be responsible for the determination and transmission of correct time.

This plan having been generally approved, and the Departments having agreed to bear each their proportion of the expense of an insulated electric circuit to connect the Observatory with the different buildings, connection was made with the following offices, the Superintendent of Public Buildings and Grounds extending every facility in his power: Office of Commissioner of Public Buildings, War Department, Navy

Department, Executive Mansion, National Museum, Smithsonian Institution, Agricultural Department, Bureau of Engraving and Printing, Capitol (Senate wing), Government Printing Office, Department of the Interior, Post-Office Department, City Post-Office, Pension Office (Twelfth street northwest) Pension Office (Thirteenth street northwest), Office of Geological Survey, Quartermaster-General's Office, Treasury Department, Department of Justice, Surgeon General's Office.

In each of these offices is a clock which is corrected daily at noon of standard time by means of an automatic attachment (the invention of Mr. W. F. Gardner, the instrument-maker of the Observatory), actuated by the electric current which makes the signal that drops the time-balls at the Observatory and on the Western Union Telegraph Company's building in New York.

THE LIBRARY.

The library is in charge of Lieut. John C. Wilson. The annual volumes for 1879 and 1880, and Appendix I, 1880, have been received and distributed. Our list of exchanges contains 433 foreign and 464 domestic addresses of scientific institutions and individuals engaged in scientific researches.

The library contains about 12,800 volumes, besides a large number of pamphlets, the accessions during the year being as follows:

By purchase	462
By exchange	450
By gift	107
Public documents	36
Total	1,055
Volumes	725
Pamphlets	330

A manuscript catalogue of the library has been completed to May 1, 1884, and is now ready for printing.

PRINTING AND BINDING.

Owing to the limited amount of the printing fund of the Department, great difficulty is experienced in obtaining the publications of the Observatory from the Public Printer with any degree of promptness. The volume for 1880, which it was expected would be ready by the 1st of January, 1884, was not received until October; the volume for 1881 has been ready for several months, but for want of funds has not yet been touched by the printer. For the same reason publications of a professional character which are in frequent use and require more substantial binding cannot be sent to the Government bindery. In view of these facts, and of the necessity which exists for promptness in these matters, I would suggest that Congress be urged to appropriate $5,000 annually for the printing and binding for the Observatory until the work in arrears be brought up. When that shall have been done a smaller sum will enable us to carry on the work of each year.

TRANSIT OF VENUS OF DECEMBER 6, 1882.

The work of reducing the various observations of this transit has been carried on during the year, under the immediate supervision of Prof. William Harkness, assisted by Messrs. R. S. Woodward, A. S.

Flint, Emil Wiessner, and A. Hall, jr. The details of the work will be found in the appended report of Professor Harkness.

MISCELLANEOUS.

During the year 1,484 persons visited the Observatory by day, and 1,344 permits were issued for night visitors, for whose accommodation the small equatorial is set apart.

A record has been kept by the various observers and the watchmen of the condition of the sky as regards seeing. From this it appears that but 126 nights were clear enough for observing, and of these but 38 are recorded as good, the remaining 88 being poor or indifferent.

I respectfully urge that the estimate made for three additional computers and for the increase in the salaries of the assistant astronomers and the instrument-maker receive the favorable consideration of the Bureau. Inasmuch as the average term of service of the assistant astronomers is but three years, owing to the fact that more lucrative positions are offered to them, it would seem to be in the interest of economy that these gentlemen should be retained in the service of the Observatory by paying them such salaries as can be obtained by them from other parties, rather than to permit their trained services to be lost. The pay now received by these gentlemen is not an adequate remuneration for the services they render. The instrument-maker has a responsible position, and his familiarity with the requirements of the place, together with his attainments and long service, merit the increase which is submitted.

Very respectfully,

S. R. FRANKLIN,
Commodore, Superintendent.

Commodore J. G. WALKER, U. S. N.,
Chief of Bureau of Navigation,
Navy Department.

[Estimate.]

NEW NAVAL OBSERVATORY.

For the purpose of erecting a new Naval Observatory and necessary buildings upon the site purchased under the act of Congress approved February 4, 1880 (21 Stat., page 64), $586,138.

Respectfully submitted.

S. R. FRANKLIN,
Commodore, Superintendent of Naval Observatory.

APPENDIX.

[Report of Prof. William Harkness, U. S. N.]

UNITED STATES NAVAL OBSERVATORY,
Washington, October 27, 1884.

SIR: I have the honor to submit the following report of the work done during the past year, under my supervision, for the Transit of Venus Commission.

The assistants engaged upon the work at the beginning of the year were Messrs. R. S. Woodward, A. S. Flint, Emil Wiessner, and A. Hall,

jr. Mr. Woodward resigned his position on the 3d of July, and Mr. Wiessner died on the 4th of August after a short illness. Both these gentlemen were excellent assistants, industrious, and thoroughly familiar with their duties, and their loss has not only been a matter of regret to the commission, but has also materially retarded the progress of the work. Messrs. Flint and Hall are still in the employ of the commission.

The measurements of the negatives of the transit obtained at the various stations were completed about the middle of August, the number of photographic plates affording satisfactory results being as follows:

	No. plates.
At Washington, D. C	50
At Cedar Keys, Fla	165
At San Antonio, Tex	121
At Cerro Roblero, N. Mex	216
At Princeton, N. J	162
At Lick Observatory, Cal	130
At New Haven, Conn	88
Total for northern hemisphere	932
At Wellington, South Africa	180
At Santa Cruz, Patagonia	211
At Santiago de Chile	197
At Auckland, New Zealand	51
Total for southern hemisphere	639

As was fully explained in last year's report, the stations at the Princeton and Lick Observatories were erected and equipped by those institutions; but as the apparatus employed was as nearly as possible identical with that of the Government parties, the negatives obtained are strictly comparable with those made at the Government stations. With the negatives made at New Haven it is quite otherwise. They owe their existence to the private efforts of Mr. R. W. Willson, and unfortunately the only apparatus he found available was of an entirely different kind from that used by the Government parties. He succeeded in obtaining 114 negatives of the transit, the image of the sun being $1\frac{1}{8}$ inches in diameter, which he very kindly offered to the Transit of Venus Commission for measurement and discussion. As these negatives seem likely to yield valuable results, the commission gladly accepted them. To sum up, then, from the Government stations 1,191 negatives have been measured; from the Princeton and Lick Observatories 292 negatives have been measured; and from New Haven 88 negatives have been measured; thus giving a grand total of 1,483 negatives, made in accordance with the methods of the commission, and 88 made by Mr. Willson's apparatus. Very considerable progress has been made in the computations necessary for the reduction of the measurements of these negatives.

In order to determine accurately the length of a second of arc upon the photographs, it is necessary to know exactly the focal lengths of the photographic objectives, and the radii of curvature of the heliostat mirrors.

The investigation of these data was begun last fall, and for the purpose of detecting and avoiding constant errors, it was decided that every determination should rest upon at least two, and whenever possible upon three, independent methods. The mirrors were taken up first. The eight belonging to the Transit of Venus Commission are as nearly as possible similar to each other, both in thickness and in mounting, but the two belonging respectively to the Princeton and Lick Observa-

tories differ somewhat from the commission mirrors and from each other. By a process entirely similar to that employed in the production of a flat surface by grinding three approximately plane surfaces upon each other, three 6-foot telescopes of 5 inches aperture were adjusted upon each other until they were all brought accurately to sidereal focus. The draw-tubes of two of these telescopes were provided with scales and verniers, by which changes in the distance of the cross-wires in the eyepiece from the objective could be read to the one-thousandth of an inch. These two telescopes being laid horizontally, and at right angles to each other, the mirror to be examined was so placed as to reflect the rays issuing from the objective of the first telescope into that of the second. If the mirror were not optically flat, it destroyed the parallelism of the rays between the two objectives, and produced a corresponding change in the position of the focal plane of the second telescope, which was measured by means of its scale and vernier. Then from the amount of this change, and the known focal distance of the telescope for parallel rays, the curvature of the mirror was computed. This process, which may be designated as the reflection method, was applied to all the mirrors. As a check upon the results obtained from it, the surfaces of all the mirrors were compared with each other, by means of a spherometer, and thus the curvature of each mirror relatively to the mean of the curvatures of all the mirrors, was found. To obtain the absolute curvature of each mirror, the mean of the curvatures found by the reflection method was made use of. The spherometer method is therefore not quite independent of the reflection method, but it is very nearly so, and the results obtained by the two methods agreed closely.

While investigating the principal focal distance of the telescope employed in the reflection method, I found that, in practice, Gauss's method of determining the quantity, by measuring four times the focal distance and subtracting the interval between the principal points, requires the addition of a correction for spherical aberration to make it rigorously exact. As a check upon the results thus obtained, the principal focal distance of the telescope in question was determined by measuring the distance from its principal focal plane (found by the three-telescope method explained above) to the back surface of the objective, and adding to it the distance from the back surface of the objective to its second principal point; and as a still further check, the principal focal distance was also found by measuring with the transit circle the angles subtended at the second principal point of the objective, by the known intervals between certain lines ruled upon a piece of glass situated in the principal focal plane. These three absolutely independent methods gave results which were almost identical.

The investigation of the photographic objectives embraced the measurement of the curvatures of all the surfaces of every objective; the measurement of the thicknesses of both the flint and crown lenses, and of the interval between them; and the measurement of the principal focal distances of the complete objectives, and also of their crown lenses, both for visual and for photographic rays. These measurements of focal distance were made by the Gaussian method, with the aid of a spectroscope, the equivalent wave-length of white light being known, and the photographic rays being determined from photographs of the solar spectrum made for another purpose some years ago. In order to get accurate measurements of the curvatures of the objectives, I found it necessary to make some additions to my spherometers, which are believed to be novel, and to develop a more exact theory of these instruments than any heretofore published. This being done, the results

obtained from three different spherometers, varying in size from 2½ to 5 inches in diameter, agreed very closely.

The important question whether or not the heliostat mirrors undergo any change of curvature when exposed to the sun's rays, yet remains to be considered. This problem has been attacked in two different ways. The first method consists in mounting the mirrors in a heliostat, one after the other, just as they were during the transit, and then, by means of a spherometer, comparing the mirror exposed to the sun with another kept in the shade. The second method consists in reflecting the sun's rays from a heliostat mirror through the photographic objective into the photographic house, and comparing the position of the sun's image thus formed with the position which it should occupy from the known focal length of the objective determined by the Gaussian method. Both these methods concur in indicating that the mirrors become very slightly concave when exposed to the sun's rays, but the investigation is still in progress, and it would be premature to give numerical results at this time.

With respect to the ordinary astronomical observations for time and latitude obtained by the various parties, it should be stated that those made at San Antonio, Cerro Roblero, and Auckland are completely reduced; those made at Cedar Keys and Santa Cruz are partly reduced, and those made at the remaining stations have not yet been advanced beyond the field reductions.

Very respectfully, &c.,

WM. HARKNESS,
Professor Mathematics, U. S. Navy, of Executive Committee United States Transit of Venus Commission.

Commodore S. R. FRANKLIN, U. S. N.,
President of Transit of Venus Commission, Washington, D. C.

NAUTICAL ALMANAC OFFICE, BUREAU OF NAVIGATION,
Washington, D. C., October 25, 1884.

SIR: I have the honor to submit the following report of the operations of this office during the past year:

Printing.—The American Nautical Almanac for the year 1887 was issued from the press in January, 1884, and the large Ephemeris for the same year in April, 1884. The American Coaster's Nautical Almanac for 1884 was issued in March, 1884. The corresponding publication for 1885 was issued in October, 1884, under the title of "The Atlantic Coaster's Nautical Almanac."

Of the Almanac and the Ephemeris for 1888, 387 pages are in type, and the printing and computations are all up to or ahead of time.

SALE AND DISTRIBUTION.

During the fiscal year ending June 30, 1884, the sale and distribution of publications was as shown in the following table:

Description.	Sold.	Distributed.
American Ephemeris	387	824
American Nautical Almanac	2,076	32
Coaster's Nautical Almanac	373	106

This statement is incomplete with respect to the American Nautical Almanac, owing to the final returns not having been received from the San Francisco agency. The amount realized from the sales was $1,015.64, which, as required by law, was deposited in the Treasury to the credit of the appropriation for public printing and binding.

COASTER'S NAUTICAL ALMANAC.

In my last annual report I called attention of the Bureau to the practice among our coasting vessels of using privately printed nautical almanacs instead of the Government publications. An inquiry into the circumstances of the case showed that this practice arose partly from the convenience which the masters of such vessels found in having all their astronomical and nautical information condensed into a single cheap pamphlet and partly from the almanacs being suggested to them by dealers. The evil was all the greater in that these publications were issued, not so much to supply a demand for almanacs on the part of navigators, as for advertising purposes; and the great number of dealers who thus deemed it necessary to engage in issuing almanacs rendered the competition a positive expense and burden from which it was believed most of them would be glad to be relieved. With the approval of the Bureau the experiment was therefore tried of issuing an American Coaster's Almanac containing, not only the astronomical matter for ordinary purposes, but tide-tables, list of light-houses, and other material necessary to the navigator on the Atlantic coast. The acknowledgments of the office are due to the Superintendent of the Coast and Geodetic Survey and to the Light-House Board for their acquiescence in the project, which involved the condensation and reprinting of data issued by them.

Believing that such a publication was yet more needed on the Pacific coast, "The Pacific Coaster's Nautical Almanac" is now in press and is expected to be ready in November. To distinguish it from this new publication, the almanac for the Atlantic coast is entitled "The Atlantic Coaster's Nautical Almanac."

METHODS OF SALE.

For a number of years the nautical publications of the office were sold at a single agency in each of the principal cities, where a discount of 20 per cent. was allowed to dealers, while the agent himself was allowed 20 per cent. more for his share in the transaction. Practically this amounted to giving some one dealer in each city a monopoly of the privilege of obtaining the larger discount, and frequently led to complaint by other dealers of their inability to obtain supplies. Desiring to avoid all causes of complaint, a system has recently been adopted which gives all dealers the right to purchase nautical publications from the office at agents' prices by paying in advance, and removes all restrictions upon the number of agencies. This system involves considerable additional labor to the office, owing to the multiplicity of small accounts thus arising, and the trouble is aggravated by occasional delay and carelessness on the part of some agents in making their returns. It is hoped that with time these drawbacks will be remedied. Should this hope not be realized, it will probably be necessary to adopt some plan of having a depot in each of the principal seaports

from which all the dealers in the vicinity can be supplied at wholesale prices. The only difficulty in the way of such a plan is to provide for the reception of and accountability for the payments received at the depot.

ASTRONOMICAL RESEARCHES.

During the past twelve months the following publications of astronomical papers supplementary to the Ephemeris have been made :

Volume II, Part I, Coefficients for Correcting Planetary Elements, by Simon Newcomb, assisted by John Meier.

Volume II, Part II, Investigations of Corrections to Greenwich Planetary Observations, 1762 to 1830, by Truman Henry Safford.

Volume III, Part I, Development of the Perturbative Function, by Simon Newcomb.

Volume III, Part II, Inequalities of the Motion of the Moon due to the Ellipticity of the Earth, by George W. Hill.

Volume III, Part III, On the Motion of Hyperion; a new case in Celestial Mechanics, by Simon Newcomb.

The first three papers give tables and data for the calculations necessary for the new tables of the planets. The work which is now being pushed forward most vigorously is that upon the four interior planets, from Mercury to Mars, which should be completed first. It is divided into two operations (1), the purely mathematical computation of the inequalities in the motion of each planet produced by the action of all the other planets, and (2) the correction of the results thus obtained so as to represent all the best observations. The first part of the work is being done in duplicate by Mr. Prentiss and Mr. Corrigan, and will, I hope, be completed during the present fiscal year. The reduction of the observations has only been fairly commenced, but will be pushed on as rapidly as the limited sum available will permit.

Theory of Jupiter and Saturn.—Mr. Hill's work on the perturbations of these two planets has progressed with little interruption, and will, it is hoped, be completed before the next annual report.

Mass of Jupiter.—This very necessary element in the tables of nearly all the planets is to be determined from the motion of the small planet Polyhymnia. The heavy part of the calculations necessary for this purpose are nearly done, and it only remains to correct the results from observations. It is intended to bring the work up to date as soon as possible, but to defer its final completion and publication until more observations can be made and used.

Velocity of light.—The computation and discussion of the velocity of light have long been completed, and are now being prepared for the press. The conclusion is that the velocity in the celestial spaces is 299,860 kilometres per second.

Very respectfully, your obedient servant,

S. NEWCOMB,
Superintendent Nautical Almanac Office.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Navigation.

A.

FOR THE SUPPORT OF THE BUREAU OF NAVIGATION.

I.—SALARIES.

For salary of chief clerk (Revised Statutes, page 70, section 416, and act of July 7, 1884)	$1,800
Increase of salary to make it equal to that of the chief clerks of other offices of the Executive Deparments (submitted)	450
* For salary of one clerk of class four (increase of $200 submitted) (Revised Statutes, page 27, section 167, and act of July 7, 1884)	1,800
For salary of one clerk of class three (increase of $200 submitted) (Revised Statutes, page 27, section 167, and act of July 7, 1884)	1,600
For salary of one clerk of class two (Revised Statutes, page 27, section 167, and act of July 7, 1884)	1,400
For salary of one clerk of class one (Revised Statutes, page 27, section 167, and act of July 7, 1884)	1,200
For salary of one clerk of class one (increase of $200 submitted) (Revised Statutes, page 27, section 167, and act of July 7, 1884)	1,200
For salary of one copyist (Revised Statutes, page 27, section 167, and act of July 7, 1884)	900
For salary of one assistant messenger (Revised Statutes, page 27, section 167, and act of July 7, 1884)	720
For salary of two laborers (Revised Statutes, page 27, section 169, and act of July 7, 1884)	1,320
Total	12,390

II.—CONTINGENT, BUREAU OF NAVIGATION.

For contingent expenses (act of July 7, 1884)	$800

B.

I.—SALARIES, NAVAL WAR RECORDS.

For salary of one agent (submitted)	$2,000
For salary of one clerk of class two (submitted)	1,400
For salary of two clerks of class one (in lieu of one now allowed, increase of $1,200, submitted) (act of July 7, 1884)	2,400
For salary of three copyists, at $900 each (submitted)	2,700
For salary of two copyists, at $720 each (act of July 7, 1884)	1,440
Total	9,940

II.—CONTINGENT, NAVAL WAR RECORDS.

For stationery, traveling of agent, and other contingent expenses (submitted)	$1,000

C.

LIBRARY, NAVY DEPARTMENT.

For books for Department library (act of July 7, 1884) (Statutes at Large, volume 22, page 555, section 1.)	$5,000

* To equalize the pay of the financial clerk with that in other Bureaus of the Department, the accounts of the Naval Observatory, Hydrographic Office, and Nautical Almanac Office being kept in this Bureau in addition to its own.

D.

COLLECTION OF NAVAL INTELLIGENCE.

For the publication of current technical information for the instruction of the *personnel* of the Navy and mercantile marine (submitted)	$10,000
For salary of one copyist (submitted)	900
For salary of one laborer (submitted)	660
Total	11,560

E.

I.—SALARIES, HYDROGRAPHIC OFFICE.

For salary of one clerk of class four (submitted)	$1,800
For salary of one clerk of class three (increase of $200, submitted) (act of July 7, 1884)	1,600
For salary of one clerk of class two (act of July 7, 1884)	1,400
For salary of one clerk of class one (act of July 7, 1884)	1,200

NOTE.—It is recommended that in place of the present appropriation of two clerks of second class and one clerk of first class, there be allowed one clerk of fourth class, one clerk of third class, one clerk of second class, and one clerk of first class, as above estimated.

For draughtsmen, engravers, copyists, copper-plate printers, printer's apprentice, assistant messenger, and laborers in the Hydrographic Office (act of July 7, 1884)	45,000
Total	51,000

II.—CONTINGENT AND MISCELLANEOUS EXPENSES, HYDROGRAPHIC OFFICE.

For purchase of chart-paper, copper-plates, electrotyping copper-plates, ink, and other materials necessary in printing division; materials for drawing division and for mounting charts; materials for engravers; for electrotyping charts for immediate use and transfer of photolithographic and other charts to copper; repairs to printing-presses; extra drawing and engraving; purchase of foreign charts and hydrographic works for the use of the vessels of the Navy; for the purchase of drawing paper, drawing materials, and necessary instruments to be furnished naval vessels while surveying; for repairs of such instruments; and for printing Pilot Chart of North Atlantic Ocean (act of July 7, 1884)	25,000
For rent of rooms for use of the presses for hydrographic printing, and for repairs and heating of the same, and for gas, water, and telephone rents (act of July 7, 1884)	1,500
Total	26,500

III.—BRANCH OFFICES.

For contingent expenses of branch offices at Boston, New York, Philadelphia, Baltimore, New Orleans, and San Francisco, including rent and care of offices, furniture, fuel, and lights; car fare and ferriage in visiting merchant vessels; freight, express, telegrams, and other necessary expenses incurred in collecting the latest information for the Pilot Chart, and for the purchase of nautical instruments (act of July 7, 1884)	5,000

F.

I.—SALARIES, NAVAL OBSERVATORY.

For salary of one assistant astronomer (increase of $700 submitted, act of July 7, 1884)	$2,600
For salary of two assistant astronomers, at $2,200 each (increase of $700 each, submitted, act of July 7, 1884)	4,400
For salary of one clerk of class four (act of July 7, 1884)	1,800
For salary of one instrument-maker (increase of $200, submitted, act of July 7, 1884)	1,700
For salary of three computers, at $1,200 each (submitted)	3,600
For salary of four watchmen, including one for new naval observatory site (act of July 7, 1884)	2,880
For salary of one skilled laborer (act of July 7, 1884)	1,000
For salary of one skilled laborer (act of July 7, 1884)	720
For salary of seven laborers, at $660 each (act of July 7, 1884)	4,620
For salary of one laborer (April 1 to October 31) (submitted)	275
Total	23,595

II.—CONTINGENT AND MISCELLANEOUS EXPENSES, NAVAL OBSERVATORY.

For miscellaneous computations (act of July 7, 1884)	1,200
For purchase of professional books and periodicals for the library (act of July 7, 1884)	1,000
For purchase of apparatus and material for repairs of instruments (act of July 7, 1884)	2,500
For repairs of buildings, for fuel, furniture, gas, chemicals, stationery, freight, postage, and all contingent expenses (act of July 7, 1884)	4,500
For payment to Smithsonian Institution for freight on publications of Observatory sent to foreign countries (act of July 7, 1884)	336
For printing and binding (submitted)	5,000
For one transit circle (submitted)	8,000
Total	22,536

G.

I.—SALARIES, NAUTICAL ALMANAC OFFICE.

For salaries of assistants in preparing for publication the American Ephemeris and Nautical Almanac, viz:	
Three assistants, at $1,600 each (act of July 7, 1884)	4,800
Two assistants, at $1,400 each (act of July 7, 1884)	2,800
Three assistants, at $1,200 each (act of July 7, 1884)	3,600
Two assistants, at $1,000 each (act of July 7, 1884)	2,000
One copyist (see note) (act of July 7, 1884)	900
One assistant messenger (act of July 7, 1884)	720
One laborer (act of July 7, 1884)	660
Total	15,480

NOTE.—Increase of $180 in salary of copyist submitted; the copyist performs also the duties of stenographer.

II.—CONTINGENT AND MISCELLANEOUS EXPENSES, NAUTICAL ALMANAC OFFICE.

For pay of computers on piecework in preparing for publication the American Ephemeris and Nautical Almanac, and improving the tables of the planets (act of July 7, 1884)	8,400
For contingent expenses Nautical Almanac Office: Stationery, boxes, expressage, books, and miscellaneous items (act of July 7, 1884)	450
Total	8,850

FOR THE NAVAL SERVICE.

I.—NAVIGATION.

For foreign and local pilotage and towage of ships of war; services and materials for correcting compasses on board ship, and for adjusting and testing compasses on shore; nautical and astronomical instruments, nautical books, maps, charts, and sailing directions, and repairs of nautical instruments for ships of war; books for libraries of ships of war; naval signals and apparatus, namely, signal lights, lanterns, rockets, running lights, drawings and engravings for signal books; compass fittings, including binnacles, tripods, and other appendages of ships' compasses; logs and other appliances for measuring the ship's way; leads and other appliances for sounding; lanterns and lamps and their appendages, for general use on board ship, including those for the cabin, wardroom, and steerage, for holds and spirit room, for decks and quartermasters' use; bunting and other materials for flags, and making and repairing flags of all kinds; oil for ships of war other than that used in the engineer department; candles when used as a substitute for oil in binnacles and running lights; chimneys and wicks, and soap used in the navigation department; stationery for commanders and navigators of vessels of war, and for use of courts martial; musical instruments and music for vessels-of-war; steering signals and indicators, and speaking tubes and gongs for signal communication on board vessels of war; and for introducing electric lights on board vessels of war (act of July 7, 1884)	$130,000

II.—OUTFIT OF MONITORS.

For navigation outfit of the five monitors authorized by Congress (submitted)	30,000

III.—OCEAN SURVEYS.

For special ocean surveys and the publication thereof (submitted)	20,000

IV.—COMPASS-TESTING HOUSE.

For erection of a compass-testing house (submitted)	7,000

V.—PUBLICATION OF PROFESSIONAL PAPERS.

For publication of professional papers (submitted)	12,000

VI.—CONTINGENT, NAVIGATION.

For contingent expenses of the Bureau of Navigation, namely: For freight and transportation of navigation materials; postage and telegraphing on public business; advertising for proposals; packing boxes and materials, and all other contingent expenses (act of July 7, 1884)	5,000

VII.—CIVIL ESTABLISHMENT, NAVIGATION.

For civil establishment at navy-yards and stations (act of July 7, 1884)	6,000

VIII.—NAVAL WAR COLLEGE.

For the care and preservation of the building on Coaster's Harbor Island, formerly known as the "asylum," and the adjoining buildings and grounds, given to the United States for naval purposes by the State of Rhode Island, and for improvements, furniture, fixtures, heating, lighting, water; purchase of feed and maintenance of a driving team and mail-wagon and attendance on same, and for books and stationery (submitted)	12,000
For the pay of one clerk to the officer in charge of the building (submitted)	1,000
Total	13,000

IX.—Survey West Coast of Mexico.

For continuing the survey of the west coast of Mexico and Central America, and the publication thereof (act of July 7, 1884) $10,000

RECAPITULATION.

FOR THE SUPPORT OF THE BUREAU OF NAVIGATION.

A.—I.	Salaries, Bureau of Navigation	$12,390
II.	Contingent, Bureau of Navigation	800
B.—I.	Salaries, Naval War Records	9,940
II.	Contingent, Naval War Records	1,000
C.	Library, Navy Department	5,000
D.	Collection of Naval intelligence	11,560
E.—I.	Salaries, Hydrographic Office	51,000
II.	Contingent and miscellaneous expenses, Hydrographic Office	26,500
III.	Branch offices	5,000
F.—I.	Salaries, Naval Observatory	23,595
II.	Contingent and miscellaneous expenses, Naval Observatory	22,536
G.—I.	Salaries, Nautical Almanac Office	15,480
II.	Contingent and miscellaneous expenses, Nautical Almanac Office	8,850
	Total	193,651

FOR THE NAVAL SERVICE.

I.	Navigation	$130,000
II.	Outfit of monitors	30,000
III.	Ocean surveys	20,000
IV.	Compass-testing house	7,000
V.	Publication of professional papers	12,000
VI.	Contingent, navigation	5,000
VII.	Civil establishment, navigation	6,000
VIII.	Naval war college	13,000
IX.	Survey west coast of Mexico	10,000
	Total	233,000

Schedule of bids received for commanding and navigating officers' stationery, under advertisement of August 2, 1884.

Wm. Ballantyne & Son*	$2,568 40
Callahan & Gartlan	2,685 00
Z. Crane, jr., & Bro.†	3,065 50
Wm. A. Wheeler, jr	2,654 10
S. Raynor & Co. (samples unsatisfactory).	
Berlin & Jones Envelope Company (samples unsatisfactory).	
Theo. E. Dollard	3,100 50

*Accepted (cloth-lined envelopes excepted), $2,343.40.
† Accepted for cloth-lined envelopes, $300.

No. 7.—BUREAU OF CONSTRUCTION AND REPAIR.

NAVY DEPARTMENT,
BUREAU OF CONSTRUCTION AND REPAIR,
Washington, D. C., November 7, 1884.

SIR: In obedience to the Department's instructions of the 25th ultimo, I have the honor to submit my annual report for the fiscal year ended June 30, 1884, showing work performed and the amounts expended, with estimates of the amounts required for the purposes of this Bureau for the fiscal year ending June 30, 1886.

The estimates of the expenses of this Bureau, as given in the statement marked A, are in accordance with existing laws.

The recommendations on this statement for increase of salary of the chief clerk of the Bureau, the draughtsman, and the assistant messenger, are respectfully submitted to your favorable consideration.

The chief clerk, under the law, acts as chief of the bureau in the absence of that officer, and must be competent to take charge of the Bureau. His duties are arduous, and fully deserve the salary herein estimated (viz, $2,250), which is the same as that paid to chief clerks in other Departments who are authorized to act in the absence of their chiefs.

The draughtsman has charge of the drawing room, and his duties are certainly fully as arduous and important as those of the draughtsman of the Bureau of Steam Engineering, who is paid $2,250 per annum.

The recommendation for three additional draughtsmen is also respectfully submitted.

This Bureau is now allowed only two draughtsmen. In order to carry on the work of designing new ships, it is absolutely and indispensably necessary that the additional force asked for be allowed.

The estimate for the pay of clerks and writers at the several navy-yards, in statement marked E, is for services which are indispensable for the proper and systematic prosecution of the work which is to be done at the yards by this Bureau. Each and every clerk and writer has specific duties to perform, which are not affected by the quantity of work doing in the yard. The same number of blanks are to be filled and the same number of reports have to be made and sent to the Bureau for its information, without regard to the quantity of work on hand.

The estimate marked B is for the general repair of vessels at navy-yards and on foreign stations, purchase of stores, materials, machinery, rights of patented articles and tools of all kinds; preservation of materials and stores, and for the general care and protection of the Navy in the line of construction and repair.

The estimate marked C is for completing the four double-turreted monitors Puritan, Terror, Amphitrite, and Monadnock. The amount required is $2,923,654.62, divided as follows:

Puritan	$955,341 56
Terror	627,287 68
Amphitrite	639,583 68
Monadnock	701,441 70

The estimate marked D is for "increase of the Navy," and provides for building seven new steel vessels, for labor in building two composite clipper barque-rigged sailing vessels for the Training Squadron, for completing the New York at the Brooklyn navy-yard, and for extra tools required in navy-yards for building iron and steel vessels. The amount asked for is $4,961,000.

The sloop of war Mohican was launched at the navy-yard at Mare Island, Cal., December 27, 1883, and can be completed for sea in about ninety working days, at an expense of about $45,000.

This vessel is of the Marion and Swatara class, which have proved very successful and satisfactory vessels in all respects. If they were armed with guns of modern type, they would be as good vessels of their class as are owned by any nation. Although the Mohican is built of wood, having a live-oak frame, she will have all the modern improvements, large air-ports of the Wilson patent, ventilating apparatus complete in all respects, and will be lighted with electricity. She is 216 feet between perpendiculars, 38 feet breadth of beam, is barque-rigged, having a sail surface of 14,150 square feet in her ten principal sails. She is designed to carry an armament consisting of one 8-inch rifle (muzzle-loader), six 9-inch, and one 60-pounder, or their equivalent weight in modern breech-loading guns. Her draught of water, when ready for sea, is intended to be 14 feet 6 inches forward and 17 feet 6 inches aft, with a corresponding displacement of 1,900 tons. With a steam capstan and a modern battery, this ship would have all the improvements of the latest modern steel cruisers, would be a valuable acquisition to the Navy, and would do good service until our wooden vessels can be replaced by those having steel hulls.

The Bureau strongly recommends the completion of the frigate New York at the Brooklyn navy-yard. This vessel has been on the stocks in one of the ship-houses since 1865; and from the fact that she was in frame before work was suspended on her, and was neither ceiled nor planked, the air has freely circulated through her timbers, and to-day they are as hard as bone and probably in better condition than any frame timbers ever put in a ship. If completed with materials that have been preserved by the Thilmany process for preserving ship timber, she would make a useful and most efficient ship of her class for twenty years. Although designed in 1865 she is an exceedingly fine model, and if finished will give us a first-class flag-ship. She can carry a battery as heavy and equally as well arranged for head and stern fire as the new cruiser Chicago has. Her length on the mean load line is 315 feet, extreme breadth of beam, 47 feet; depth from lower edge of rabbet of keel to lower port sill on gun deck, 25 feet 11 inches. She is designed to have a ship's rig, having 24,000 square feet of sail surface in her ten principal sails. Her displacement at a draught of 18 feet 9 inches forward, and 21 feet 5 inches aft, would be equal to 4,527 tons, and her lowest port sill on the gun deck would be 8 feet above water. The plans for finishing this vessel are in such a condition that they could be completed in a very short time, and the work on her, if authorized, could be pushed to completion and the vessel put afloat within six months from the time it is resumed. To permit of doing this work without having to draw so heavily upon the regular appropriations for construction and repair, the Bureau has estimated for $400,000, which it is thought will be sufficient to complete her.

The old sailing sloops of war, Saratoga, Jamestown, and Portsmouth, are rapidly approaching such a condition that, ere long, they will require larger expenditures of money for their repair than the law allows.

The loss of these vessels would leave the service without suitable training ships. To meet this emergency I respectfully recommend the construction, at an early day, of two composite built, auxiliary steam power, barque-rigged clipper ships, of fine models, 800 tons displacement, and light sparred, designed expressly for training boys for the naval service. For this purpose I have estimated for an appropriation of $250,000.

The armor for the turrets, pilot-houses, and armored stack for the double-turreted monitor Miantonomoh, contracted for by this Bureau, through William H. Wallace & Co., with Messrs. John Brown & Co., of the Cyclops Works, and Messrs. Charles Cammell & Co., of Sheffield, England, have all been delivered at the Brooklyn navy-yard, except one port plate and the pilot-house plates, the former having been rejected and a new one making to replace it. The work of altering the decks and internal arrangements of the vessel to accommodate the new roller-base turrets is well in hand at the Brooklyn yard, and the turrets are in course of erection in the iron-plating shop of that yard.

The Bureau has estimated for the necessary amount of money to complete the work, in construction department, on the double-turreted monitors Puritan, Amphitrite, Terror, and Monadnock, and trusts that Congress will appropriate the amount asked for ($2,923,654.62), that these vessels may be completed. While there has been an appropriation made to put in the machinery and boilers, the work under this Bureau remains at a standstill. When it is considered how intimately connected the work of the Bureau having charge of the machinery is with that of this Bureau, it is difficult to conceive how the contract for machinery can be completed without at the same time doing some work on the hull, which is almost directly connected with the work of putting in boilers and machinery, and which should be carried on at the same time.

The pumps of all descriptions, for pumping and draining purposes, as also the ventilating system, have been included in the contract for steam machinery for the Puritan (and I presume for the other vessels), and yet it is a fact that before this is completed there is a large amount of work coming under the cognizance of this Bureau which must be done, while there is no authority of law to do it, and no funds to pay for it if ordered.

I cannot too strongly urge the completion of these vessels in all respects at an early day, as they will afford as good vessels of their class as are owned by any nation, and, in my opinion, the best type of coast and harbor defense vessels in existence to-day. It will take at least a year to obtain their side and turret armor after it is authorized; and under existing circumstances it would have to come from abroad, as there are no manufacturers of compound armor in this country, and probably no establishment that would be willing to invest such a large amount of money as would be required to obtain the necessary plant for doing the work for these four vessels with little or no prospect for more work of the same kind in the future. It therefore seems very necessary that money for armor, if for nothing more, should be appropriated at an early day, in order that contracts for securing it may be made with as little delay as possible. The completion of these monitors should no longer be delayed. When completed we will have five splendid coast and harbor defense iron-clads. Should occasion require it, they can be sent to distant points; their seaworthiness has been well tested in the past.

Under the Department's instructions of the 8th October, ultimo, the Bureau has now in process of preparation the plans for the hulls of the

following-described new steel vessels, as called for by the Naval Advisory Board:

	3,000 ton cruiser.	Heavily armed gunboat.	Heavily armed gunboat.	Armed despatch boat.	Light cruising gunboat.	Armed ram.
Light between perpendiculars.	290′	220′	220′	250′	175′	200′
Extreme breadth	42′	35′	35′	35′	28′ 6″	47′
Mean draft of water	16′ 10″	13′ 10″	13′ 10″	14′ 3″	10′	17′
Load displacement	3,100	1,600	1,600	1,550	800	3,000
Speed knots. Smooth water.	14	14	14	16	11	17
Speed knots. Sea speed	13	13	13		10	
Main battery	Four 6 in. (in sponsons). Four 5 in. (in broadside). Two 5 in. (in bow ports). One 5 in. (in stern).	Two 8 in. (in centre). Two 5 in. (in sponsons).	One 10 in. (in center for'd). One 6 in. (in center aft). Two 5 in. in sponsons).	2.33mm S. 6.37mm S.H.P. 6 47mm Rev. 3.37mm S.L.P. One short Gatling.	Six 5 in.	4.37mm. 4 Gatli'gs.
Secondary battery	2.57mm S. 4.47mm R. 2.37mm R. 2.37mm S. 2 Gatlings.				2.37mm R. 1.37mm S. 1 Gatling.	
Rig	Bark.	Hermaphrodite.	Hermaphrodite.	Barkentine.	Barkentine.	
Area of plain sail	11,000 sq. ft.	8,000 sq. ft.	8,000 sq. ft.	8,000 sq. ft.	5,000 sq. ft.	
Coal capacity	500 tons.	250 tons.	250 tons.	300 tons.	150 tons.	(*)
I. H. power	3,500	1,600	1,600	2,200	650	4,000
Screws. Single or twin.	Twin.	Twin.	Twin.	Single.	Single.	Twin.
Screws. Diameter	14′ 0″	11′ 6″	11′ 6″	14′ 6″	9′ 0″	14′ 0″
Screws. Pitch	19′ 0″	16′ 6″	16′ 6″	24′ 0″	12′ 9″	21′ 0″

* Not stated.

While it is generally supposed that our navy-yards are not in condition to build steel vessels, and that it would entail a very large expenditure of money to obtain the necessary tools, it is nevertheless a fact that, with probably the exceptions of a few improved tools required for the preparation of plates, beams, and angles, and the erection of furnaces for heating angle-irons and plates, there is no private establishment in this country, carrying on iron or steel ship-building, which has better facilities for such work than can be found in our navy-yards, and few indeed, if any, that can compare with them in all respects.

The Government has means and appliances for doing work which no private establishment could afford, and the character of the work done in our navy-yards has never been questioned. During our late civil war the Government called to its assistance every available private establishment in the country which was capable of building or repairing a vessel, or of converting a merchant vessel into an armed vessel for blockade or cruising purposes, but which, together with every navy-yard worked to its utmost capacity, were unable to meet the demands for work with the dispatch required. Had it been a foreign war, with our vessels returning from sea badly disabled in action and requiring prompt repair, the results would undoubtedly have been terribly disastrous, owing to lack of dry-docks, materials, and appliances of every kind.

At the present time we have but few private establishments which, in the event of war, could commence and carry on, with any degree of rapidity, the building of steel ships, while but one navy-yard is, or soon will be, in condition to do such work. In order to be able to meet any trouble which may arise in the future, and which all nations are liable

to, it seems that the wisest and certainly the most economical course for this Government to pursue is, to immediately equip its navy-yards with the necessary tools and plant for building such steel armored or unarmored vessels as the necessities of the service may demand; and for this purpose the Bureau has asked that it be assisted in this work by the appropriation of $150,000.

During the past year the Intrepid, a twin-screw iron vessel of 1,150 tons displacement, originally built for an armored torpedo-boat, has been hauled out on the slip where the frigate Trenton was built, at the Brooklyn navy-yard, her armor removed, and the vessel cut down, with a view to converting her into a gunboat for service in the Chinese squadron. A strong and substantial shed has been erected alongside this ship, in one end of which an angle and plate iron furnace has been built and floors laid. The necessary work of erecting the tools now available, and such as have been purchased during the year, will soon be completed, together with the necessary bending and beveling slabs; so that by January 1, 1885, the Bureau expects to have the construction department of the Brooklyn navy-yard in condition to build any steel vessel that might be required. The iron-plating shop in this yard, in which the turrets of the Miantonomoh are now in course of erection, is well equipped for ship-work of all kinds that would be needed in connection with the work of building steel vessels, steel spars, boats, blocks, tanks, and metal fittings of all kinds used in the construction or equipment of a vessel of war.

In the event of an appropriation being made for more steel ships, the Bureau hopes that at least one-half of the ships may be built in our navy-yards, in competition, as to cost and character of work, with outside establishments. The Bureau does not wish to be understood as opposing the building of naval vessels by private establishments under contract; it believes that one-half of the vessels appropriated for should be built by contract, but in competition with the Government navy-yards; the cost of work in the navy-yards can thereby be reduced, and the contractors and workmen in private establishments educated up to the requirements of a vessel for the naval service, which, at the present time, are understood by so few, as the work and fittings incident to such a vessel differ so materially from those of a merchant ship. By this means, in the event of a sudden call for vessels, private ship-builders would be capabie of furnishing suitable ships for the naval service, while the Department Bureau, and Inspectors would have much less trouble in the execution of the work, and there would be less litigation than heretofore during and after the completion of the contracts.

Common sense and patriotism require that our navy-yards should be put in a first-class condition of efficiency. The Navy is now so greatly reduced in the number of its vessels that we must of necessity build many new and modern steel vessels within a few years, if we are to have any navy at all.

Steel vessels cannot be kept clean without periodical docking and cleaning of their bottoms, and the attention of the Department is invited to the great want of proper docking facilities in our navy-yards. The recommendations made by Rear-Admiral E. T. Nichols, chief of the Bureau of Yards and Docks, on this important subject, are fully concurred in by this Bureau. In the event of a maritime war, this deficiency would be seriously felt, perhaps to a greater extent than any other of our pressing wants, and it is worthy of consideration whether immediate steps should not be taken to place our navy-yards, in this respect, in a thorough con-

dition of effectiveness. While other powers are increasing their dry-dock facilities, already greater in one yard than are in all of ours combined, we are doing comparatively nothing in this direction.

On the recommendation of this Bureau, and by direction of the Department, Naval Constructor Philip Hichborn was detailed, on the 2d of June last, to proceed to Europe for the purpose of observing personally the improvements in naval architecture, particularly in the construction of steel vessels of war. He was directed to visit all the important government and private dock-yards, and to examine the improved classes of vessels completed and in process of construction, and to closely observe the arrangements and tools for iron and steel ship construction, and to collect such information on these, as well as all other matters connected with the construction and equipment of modern vessels, as possible.

Constructor Hichborn sailed from New York on the 14th of June, in the City of Rome, and returned to the United States in the same vessel on the 27th ultimo. During his absence he has visited England, Scotland, Wales, Germany, France, and Russia, visiting all the most important establishments, public and private, in those countries. Since his return he has been detached from duty at the naval station at League Island and ordered to duty in the Bureau.

So far as the Bureau has been able to judge, in the limited space of time since his return, the results of his labors have been more than satisfactory. He met with a cordial reception wherever he went, and has made good use of his time while abroad. He is now at work on his report, which, when made, will be the most complete ever made upon the subject.

Under act of Congress approved March 3, 1883, and in accordance with orders of the Department, the following vessels have been broken up:

Canandaigua, 2d rate, 2,130 tons displacement, at Norfolk yard.

Snowdrop, tug, 125 tons displacement, at Norfolk yard.

Connecticut, 2d rate, 4,450 tons displacement, at Boston yard.

Under the same authority the following vessels are now in process of breaking up:

Plymouth, 2d rate, 2,400 tons displacement, at Kittery yard.

Massachusetts, monitor, 2d rate, 2,127 tons displacement, at Kittery yard.

Oregon, monitor, 2d rate, 2,127 tons displacement, at Boston yard.

Pennsylvania, 2d rate, 4,000 tons displacement, at Boston yard.

Virginia, sailing frigate, unfinished, 4,150 tons displacement, at Boston yard.

Java, 2d rate, 4,000 tons displacement, at Brooklyn yard.

Colossus, monitor, 2d rate, 2,127 tons displacement, at Brooklyn yard.

In a very short time these vessels will have ceased to exist, and the valuable room so long occupied by them in and out of ship-houses will be available for the work of the future.

Under the orders of the Department of October 24, 1883, the Monongahela, 2d rate, was converted into a store-ship by removing her boilers and engines, and thus enabling her to carry a large supply of coal and other necessary stores to Callao for the use of the Pacific squadron, relieving the Onward, which vessel was in such a condition as to be unsafe to even lay at her anchorage much longer. The Monongahela is now in fine condition, and will last many years, and do good service as a store-ship.

The Bureau is strongly in favor of converting the Ticonderoga, now at the Brooklyn navy-yard, into a school-ship for the Naval Academy, to take the place of the Dale, an old sloop of war now used for that purpose.

The frigate Constellation, having been thoroughly repaired during the past year at the Norfolk yard, would, with the Ticonderoga, give the Academy two good practice-ships, capable of going anywhere with safety, and with comfort for all on board.

The Ticonderoga could be put in dock, her engines and boilers removed, the berth deck extended the entire length of the ship, and the hold space, not otherwise wanted, filled with water-tanks. If this vessel is sold she will not bring much, and the proceeds of sale would be of no benefit to the naval service. This recommendation, I know, meets with the entire approval of Capt. F. M. Ramsay, Superintendent of the Naval Academy.

In concluding this report, I beg leave respectfully to invite your attention to the present very low condition of the appropriation for construction and repair:

On the 1st of July, 1884, the balance on hand was		$48,026
Appropriated per act of July 7, 1884, for six months ending December 31, 1884		550,000
		598,026
Expended for labor at yards to November 1	$266,733	
Allowed for labor at yards for November	79,345	
Expended for materials to November 1	67,107	
Expended for materials to November 1, still unpaid, including raising of Tallapoosa	105,895	
Bills paid for ships on foreign stations	48,864	
		567,944
Amount available for labor at yards for December; Amont available for materials at yards for November and December; Amount available for foreign bills to December 31, 1884		30,082
Estimated amount required for labor at yard for December		75,000
Estimated amount required for materials for November and December		15,000
Estimated amount required for foreign bills to December		10,000
		100,000

The following vessels are now under repairs or awaiting repairs, viz: At the Kittery yard, the Omaha; at the New York yard, the Tennessee, Swatara, Intrepid, Yantic, Alliance, Vermont, Miantonomoh, Richmond, and Brooklyn; at the Norfolk yard, the Pensacola, Wyoming, Jamestown, Saratoga, and Portsmouth; at the Mare Island yard, the Mohican and Adams.

It will be seen from the above statement that without the additional amount of $70,000 the repairs on the above ships, and construction work generally in our navy-yards, must be virtually suspended during the month of December next.

The Bureau desires to state here that every exertion has been made to exercise economy in all its expenditures, and no repairs have been authorized by it, except such as were reported under its instructions to be absolutely necessary to fit the respective ships for service.

I am, sir, very respectfully, your obedient servant,

T. D. WILSON,
Chief of Bureau.

Hon. WM. E. CHANDLER,
Secretary of the Navy.

A.—*Estimates of appropriations required for the service of the fiscal year ending June* 30, 1886, *by the Bureau of Construction and Repair.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1885.
SALARIES.			
Chief clerk (act of July 7, 1884)	$1,800 00		
Draughtsman (act of July 7, 1884)	1,800 00		
One clerk of class four (act of July 7, 1884)	1,800 00		
One clerk of class three (act of July 7, 1884)	1,600 00		
One clerk of class two (act of July 7, 1884)	1,400 00		
One assistant draughtsman (act of July 7, 1884)	1,400 00		
One clerk of class one (act of July 7, 1884)	1,200 00		
One assistant messenger (act of July 7, 1884)	720 00		
One laborer (act of July 7, 1884)	660 00		
Increase of salary of chief clerk (submitted)	450 00		
NOTE.—The chief clerk, under the law, acts as chief of Bureau in case of the death, illness, resignation, or absence of that officer, and must be competent to take charge of the Bureau. The duties of this office are arduous, and fully deserve the salary herein estimated, it being the same amount ($2,250) paid to chief clerks in other Departments who are authorized to act in the absence of their chiefs.			
Increase of salary of draughtsman (submitted)	450 00		
NOTE.—As the duties of the draughtsman of this Bureau are certainly fully as arduous and important as those of the draughtsman of the Bureau of Steam Engineering, who is paid $2,250 per annum, this increase is submitted as just and proper in the case.			
Three draughtsmen, at $1,400 per annum (submitted)	4,200 00		
Restoring assistant messenger to rank of messenger, with pay of such (submitted)	120 00		
		$17,600 00	$12,380 00
CONTINGENT.			
Stationery and miscellaneous items (appropriated)	600 00	*600 00	

* In bulk to Department.

B.—*Estimates of appropriations required for the service of the fiscal year ending June* 30, 1886, *by the Bureau of Construction and Repair.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the six months ending December 31, 1884.
CONSTRUCTION AND REPAIR OF VESSELS.			
Preservation and completion of vessels on the stocks and in ordinary; purchase of materials and stores of all kinds; labor in navy-yards and on foreign stations; purchase of machinery, rights of patented articles and tools for use in shops; wear, tear, and repair of vessels afloat, and for general care, increase, and protection of the Navy in the line of construction and repair; incidental expenses, such as advertising, foreign postages, telegrams, photographing, books, plans, stationery, and instruments for drawing-room (appropriated)	$1,750,000 00	$1,750,000 00	$550,000 00

C.—*Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Construction and Repair.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1885.
DOUBLE-TURRETED MONITORS.			
Completing four double-turreted monitors, as follows:			
Puritan (appropriated)	$955,341 56		
Terror (appropriated)	627 287 68		
Amphitrite (appropriated)	639,583 68		
Monadnock (appropriated)	701,441 70		
		$2,923,654 62	

D.—*Estimates of appropriations required for the service of the fiscal year ending June 30, 1866, by the Bureau of Construction and Repair.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1885.
INCREASE OF THE NAVY.			
For building the following new steel vessels:			
One cruiser of 4,500 tons (submitted)	$650,000 00		
One cruiser of 3,100 tons (submitted)	465,000 00		
One dispatch vessel of 1,550 tons (submitted)	240,000 00		
Two heavily armed gunboats of 1,600 tons each, each $231,000 (submitted)	462,000 00		
One light gunboat of 800 tons (submitted)	141,000 00		
One 900-ton gunboat (submitted)	158,000 00		
One cruising torpedo-boat (submitted)	32,000 00		
Two harbor torpedo-boats (submitted)	13,000 00		
One sea-going armored vessel of 8,500 tons displacement (submitted)	2,000,000 00		
		$4,161,000 00	
For completing the New York at the Brooklyn navy-yard (submitted)	400,000 00		
Labor in building two composite clipper barque-rigged sailing vessels, 800 tons each, with auxiliary steam-power and lifting screws, for Training Squadron (submitted)	250,000 00		
Extra tools required in navy-yards for building iron and steel vessels (submitted)	150,000 00		
	4,961,000 00		

E.—*Estimates of appropriations required for the service of the fiscal year ending June 30, 1866, by the Bureau of Construction and Repair.*

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1865.
CIVIL ESTABLISHMENT.			
At the navy-yard, Kittery, Me.:			
One clerk to naval constructor	$1,400 00		
One clerk of storehouses	1,300 00		
Three writers, at $1,017.25 each	3,051 75		
		$5,751 75	
At the navy-yard, Boston, Mass.:			
One clerk to naval constructor	1,400 00		
One clerk of storehouses	1,300 00		
		2,700 00	
At the navy-yard, Brooklyn, N. Y.:			
One clerk to naval constructor	1,400 00		
One clerk of storehouses	1,300 00		
Three writers, at $1,017.25 each	3,051 75		
		5,751 75	
At the navy-yard, League Island Pa.:			
One clerk to naval constructor	1,400 00		
One clerk of storehouses	1,300 00		
		2,700 00	
At the navy-yard Washington, D. C.:			
One clerk to naval constructor	1,400 00		
Two writers, at $1,017.25 each	2,034 50		
		3,434 50	
At the navy-yard, Norfolk, Va.:			
One clerk to naval constructor	1,400 00		
One clerk of storehouses	1,300 00		
Three writers, at $1,017.25 each	3,051 75		
		5,751 75	
At the navy-yard, Pensacola, Fla.:			
One writer	1,017 25		
		1,017 25	
At the navy-yard, Mare Island, Cal.:			
One clerk to naval constructor			
One clerk of storehouses	1,400 00		
Three writers, at $1,017.25 each	1,300 00		
	3,051 75		
		5,751 75	
		*32,858 75	

* In bulk to Department.

No. 8.—BUREAU OF STEAM ENGINEERING.

NAVY DEPARTMENT, BUREAU OF STEAM ENGINEERING,
Washington, November 10, 1884.

SIR: In obedience to your order of October 24, I have the honor to submit to the Department the annual report of this Bureau for the past year, together with the estimates for the fiscal year 1885-'86, and estimates for new vessels proposed for the United States Navy:

APPROPRIATION, STEAM MACHINERY, 1884.

Amount appropriated for fiscal year 1883-'84, act approved March 3, 1883		$1,000,000 00
Expended:		
For labor in navy-yards and stations, in constructing new engines, boilers, and their dependencies; repairing old boilers, machinery, &c., and fitting vessels for sea service; preservation of tools; handling and preservation of materials and stores	$599,502 13	
For purchase of materials, stores, machine-tools, freights, and incidental expenses	327,959 69	
For payments on foreign stations for repairs, materials, &c	77,455 92	
		1,004,917 74
Less repayments by transfers in adjustment of appropriations		11,152 99
Total expenditure		993,764 75
Balance on hand		6,235 25

This balance of $6,235.25, however, is covered by obligations of the Bureau for purchases, &c., at home and abroad, the vouchers for which have not yet been received or the accounts not yet settled.

APPROPRIATION, MACHINERY, DOUBLE-TURRETED MONITORS.

Balance on hand as per report dated October 30, 1883	$863,262 49
Expended since this report was made, to date, under contracts for engines, &c., for Puritan, Terror, and Amphritite	327,454 28
Balance on hand	535,808 21

The larger part of this balance will be required to pay for the completion of engines, &c., for monitors Puritan, Terror, and Amphitrite, now under contract.

GENERAL OPERATIONS OF THE BUREAU.

The following table will exhibit the character and cost, for labor and materials, of the work done under cognizance of this Bureau for the fiscal year ending June 30, 1884, upon the machinery, boilers, &c., with

outfits, stores, &c., of naval vessels, and the expenditures for maintenance, &c., at the several navy-yards and stations:

Name of vessel.	Rate.	Engines, boilers, and machinery.	Stores and outfits.	Total.	Remarks.
Adams	3d	$26,849 76	$3,073 59	$29,923 35	New boilers nearly completed.
Ajax	Iron-clad		707 07	707 07	Preserving machinery.
Alarm	Torpedo-ram	889 26	2,806 40	3,695 66	In service.
Alert	3d	19,873 75	5,291 78	25,165 53	Stores for three years' cruise; new boilers completed; in service.
Alliance	3d	19,581 98	666 53	20,248 51	New boilers being built; in service.
Amphitrite	Iron-clad	34,785 38		34,785 38	Contract for machinery.
Brooklyn	2d	99 09	1,034 41	1,133 50	In service.
Canandaigua	2d	41 48		41 48	Preserving machinery.
Catalpa	Tug	2,658 08	371 90	3,029 98	In service; general repairs made.
Cohasset	Tug	4,942 68	1,405 03	6,347 71	Do.
Colorado	1st	713 05	72 23	785 28	Slight repairs made.
Despatch	4th	597 60	1,346 10	1,943 70	In service.
Dolphin	4th	2,000 00	602 87	2,602 87	Steam-launch and stores.
Emerald	Tug	260 25		260 25	In service.
Enterprise	3d	74 97	1,181 10	1,256 07	Do.
Essex	3d	3,740 93	1,953 73	5,694 66	In service; general repairs made.
Fortune	Tug	1,496 16		1,496 16	Do.
Franklin	1st	530 10	2,111 45	2,641 55	Receiving-ship, Norfolk, Va.
Galena	3d	24,561 54	5,529 73	30,091 27	In service; extensive repairs to engines and boilers; stores for three years.
Hartford	2d	5,991 90	2,071 87	8,063 77	In service; new steam-launch; slight repairs made.
Intrepid	Torpedo-ram	4,031 66		4,031 66	Alterations and repairs being made.
Iroquois	3d	35 21	14 86	50 07	In service.
Jamestown	3d	3,593 84	113 60	3,707 44	In service; repairs to steam-launch and heaters.
Jason	Iron-clad	626 18		626 18	Preserving machinery.
Juniata	3d	26 18	1,001 54	1,027 72	In service.
Kearsarge	3d	3,756 42	5,756 71	9,513 13	In service; general repairs made; stores for full cruise.
Lackawanna	2d	595 62	2,452 64	3,048 26	In service.
Lancaster	2d	649 01	2,384 08	3,033 09	In service.
Leyden	Tug	254 35		254 35	In service.
Marion	3d	70,100 57		70,100 57	New boilers completed.
Mayflower	Tug	4,218 19		4,218 19	General repairs being made.
Miantonomoh	Iron-clad	13,808 08	3,389 92	17,198 00	General repairs made.
Michigan	4th	272 53	17 12	289 65	In service.
Minnesota	1st	1,477 75	1,066 82	2,544 57	Gunnery training-ship.
Mohican	3d	82,147 30		82,147 30	New engines and boilers being built.
Monadnock	Iron-clad	36,209 79		36,209 79	Preparing machinery for launching (contract).
Monocacy	3d	34,720 31	1,863 54	36,583 85	In service; new boilers being built.
Monongahela	2d	4,761 74		4,761 74	Preparing as a store-ship at Callao, Peru.
Montauk	Iron-clad	698 45		698 45	Preserving machinery.
Monterey	Tug	10,952 94		10,952 94	In service; new boilers being built.
Nahant	Iron-clad	209 54		209 54	Preserving machinery.
Nantucket	Iron-clad	5,063 68		5,063 68	In service; extensive repairs made.
New Hampshire	1st	401 73	108 80	510 53	In service.
New York	1st	81,458 58		81,458 58	New boilers nearly completed.
Nina	Tug	20,582 50	910 80	21,493 30	In service; extensive repairs and changes completed.
Nipsic	3d	414 40	795 34	1,209 74	In service.
Omaha	2d	26,820 18		26,820 18	New boilers nearly completed.
Onward	4th	61 15		61 15	Store-ship at Callao, Peru.

Name of vessel.	Rate.	Engines, boilers, and machinery.	Stores and outfits.	Total.	Remarks.
Ossipee	3d	$151, 951 75	$7, 587 13	$159, 538 88	In service; new boilers completed and repairs made; stores for 3 years' cruise.
Ounalaska	Schooner	613 37	226 74	840 11	In service.
Palos	4th	6, 271 55	838 81	7, 110 36	In service; general repairs made.
Passaic	Iron-clad	87 38	....	87 38	Preserving machinery.
Pawnee	3d	52 83	....	52 83	Repairs to steam-launch.
Pensacola	2d	318 17	1, 409 28	1, 727 45	In service.
Pilgrim	Tug	67 41	153 53	220 94	In service.
Pinta	Tug	3, 864 63	1, 636 57	5, 501 20	In service; repairs made.
Powhatan	2d	16, 226 56	5, 346 31	21, 572 87	In service; repairs to engines and boilers made.
Puritan	Iron-clad	324, 540 73	....	324, 540 73	Contract for machinery.
Quinnebaug	3d	29, 937 46	4, 783 18	34, 720 64	In service; extensive repairs to machinery: stores for full cruise.
Ranger	3d	2, 407 36	856 19	3, 263 55	In service; repairs.
Rescue	Tug	40 36	....	40 36	In service.
Richmond	2d	1, 509 74	1, 831 99	3, 341 73	In service; repairs and new tubes.
Rocket	Tug	7, 732 76	705 91	8, 438 67	In service; new boilers being built.
Saratoga	3d	42 63	....	42 63	In service.
Shawmut	3d	130 80	....	130 80	Preserving machinery.
Shenandoah	2d	15, 926 10	9, 433 03	25, 359 13	In service; repairs to engines and boilers; stores for three years' cruise.
Snowdrop	Tug	549 77	54 74	604 51	Removing machinery.
Speedwell	Tug	2, 820 99	1, 444 45	4, 265 44	In service; general repairs made.
Standish	Tug	4 60	....	4 60	In service.
Swatara	3d	9, 300 37	4, 071 71	13, 372 08	In service; general repairs to machinery.
Tallapoosa	4th	4, 047 71	4, 139 52	8, 187 23	General repairs.
Tennessee	1st	4, 630 46	5, 752 23	10, 382 69	In service; general repairs.
Terror	Iron-clad	52, 178 10	....	52, 178 10	Contract for machinery.
Trenton	2d	11, 593 84	11, 925 98	23, 519 82	In service; general repairs; stores for three years' cruise.
Triana	Tug	1, 540 60	243 61	1, 784 21	In service; repairs.
Vandalia	2d	7, 568 80	857 43	8, 426 23	In service; new boilers being built.
Vermont	2d	643 99	83 62	727 61	Receiving-ship at New York yard.
Wabash	1st	97 81	893 21	991 02	Receiving-ship at Boston yard.
Wachusett	3d	398 63	459 72	858 35	In service.
Worcester	2d	88 58	....	88 58	Preserving machinery.
Wyandotte	2d	74 29	327 61	401 90	Receiving-ship at Washington yard.
Wyoming	3d	571 20	....	571 20	Repairs to boilers.
Yantic	3d	10, 959 32	1, 000 70	11, 960 02	In service; extensive repairs to machinery.
Total	....	1, 226, 426 49	116, 164 76	1, 342, 591 25	

Expenditures at navy-yards and stations not included in the amount expended on naval vessels.

Navy-yards.	Yard expenses.	Miscellaneous.	Total.
Portsmouth, N. H	$26, 462 48	$1, 705 12	$28, 167 60
Boston, Mass	17, 840 75	....	17, 840 75
Brooklyn, N. Y	58, 857 37	49, 022 88	107, 880 25
League Island, Pa	15, 747 60	1, 469 22	17, 216 82
Washington, D. C	24, 030 56	31, 335 18	55, 365 74
Norfolk, Va	81, 904 69	655 06	82, 559 75
Pensacola, Fla	4, 453 75	727 56	5, 181 31
Mare Island, Cal	57, 342 67	2, 484 71	59, 827 38
New London, Conn	972 49	....	972 49
Key West, Fla	1, 784 11	551 59	2, 335 76
Foreign stations	....	3, 131 16	3, 131 16
Total	289, 396 47	91, 082 48	380, 478 95

NAVY-YARDS.

In relation to the condition of the departments under cognizance of this Bureau at the several navy-yards it is scarcely necessary to do more than to call attention to the very thorough and complete report of the Commission on Navy-Yards, dated December 1, 1883, and printed in Senate Ex. Doc. No. 55, Forty-eighth Congress, first session.

The Bureau would, however, emphasize their recommendation for a new boiler-shop at the New York navy-yard, as the building now used for the purpose is not large enough to accommodate the work, and it is so constructed that the machine-tools necessary to the expeditious and economical construction of steam-boilers cannot be erected there.

In this connection it is proper to state that the floating derrick, one of the most useful and necessary appendages of the New York navy-yard, is in need of extensive repairs. Being constructed of wood and very old, it is not thought advisable to make any considerable outlay upon the hull, but it is proposed to rebuild the same of iron as soon as practicable, for which plans and estimates are now being prepared.

The Bureau takes pleasure in calling attention to the gratifying results from its efforts, referred to in the report of my predecessor, to carry into practical effect the suggestions of the Navy-Yard Commission, approved and ordered by you, for a reduction of the expenditures at the navy-yards for their maintenance and organization which do not enter into the accounts of expenditure upon naval vessels. For previous years the cost of this maintenance and organization under this Bureau was about 38 per cent. of the total expenditures of the Bureau for a fiscal year, but during the past fiscal year this was reduced to about 22 per cent. This is probably as low a percentage as can be maintained, having due regard to the efficient superintendence of the work done upon steam machinery of naval vessels at navy-yards, the purchase and preservation of tools and appliances for such work, and the adequacy of the clerical force.

The Bureau will continue to carry out this policy, and will make further reductions wherever it can be shown to be for the best interests of the Government.

PRESENT CONDITION OF MACHINERY OF NAVAL VESSELS, WITH THE WORK REQUIRED ON EACH.

The following will show the present condition and the work required to be done to the machinery of naval vessels to fit them for efficient sea-service, according to latest reports, with an approximate estimate of the cost of the same:

Adams (3d rate).—At Mare Island navy-yard, undergoing general overhauling and repair of engines, with new crank-shaft and new boilers to be completed and put in. ($35,000.)

Alliance (3d rate).—In service. In fair condition, but will shortly have to be generally overhauled and repaired, with new boilers completed and put in. These boilers are in progress of construction at the Norfolk navy-yard (material all on hand). ($60,000.)

Alert (3d rate).—In service. In good condition.

Ajax (iron-clad).—In good state of preservation. Would have to be repaired with new boilers for sea-service. ($40,000.)

Alarm (torpedo ram).—In fair condition.

Brooklyn (2d rate).—General overhauling and repair, &c. ($10,000.)

Catalpa (tug).—In service. Ordinary repairs. ($2,000.)

Canonicus (iron-clad).—In good state of preservation. Would have to be repaired, with new boilers, for sea-service. ($40,000.)

Camanche (iron-clad).—Well preserved. Could be made ready for sea-service at small cost. ($2,000.)

Catskill (iron-clad).—Well preserved. Could be made ready for sea-service at small cost. ($2,000.)

Cohasset (tug).—In service. In good condition.

Despatch (4th rate).—In service. In good condition.

Enterprise (3d rate).—In service. In good condition.

Essex (3d rate).—Will shortly require general overhauling and repair of engines; new boilers (material on hand) completed and put in. ($55,000).

Fortune (tug).—Repairs, with new boilers, to be completed at the Norfolk navy-yard. ($3,000.)

Franklin (1st rate).—Requires new boilers (now on hand) to be put in, and machinery thoroughly overhauled and repaired, to fit for sea-service. ($30,000.)

Galena (3d rate). In service. In fair condition. Will soon require new boilers ($65,000.)

Hartford (2d rate).—In service. In good condition.

Iroquois (3d rate).—In service. In fair condition.

Intrepid (torpedo-ram).—Undergoing alterations at New York navy-yard to fit her for a gunboat. ($14,000.)

Jason (iron-clad).—Well preserved. To prepare for service. ($2,000.)

Juniata (3d rate).—In service. In good condition.

Kearsarge (3d rate).—In service. In fair condition.

Lackawanna (2d rate).—In service. In very poor condition. Will soon need to be repaired, with new boilers. ($75,000.)

Lancaster (2d rate).—In service. In fair condition.

Lehigh (iron-clad).—In fair state of preservation. To make ready for service. ($3,000.)

Leyden (tug).—In service. Usual repairs incident to continuous service. ($2,000.)

Marion (3d rate).—Has had thorough overhauling and repair, with new boilers, nearly completed, at Portsmouth (N. H.) navy-yard; will then be efficient for sea-service for several years.

Mahopac (iron-clad).—In good state of preservation. To fit for service. ($3,000.)

Manhattan (iron-clad).—In fair state of preservation. To fit for service. ($4,000.)

Mayflower (tug).—In service.

Michigan (4th rate).—In service. Should have thorough overhauling and repair, with new boilers. ($25,000.)

Minnesota (1st rate).—Requires extensive repairs and new boilers. To fit for sea-service. ($75,000.)

Mohican (3d rate).—Work on new compound machinery nearly completed at Mare Island navy-yard. ($5,000.)

Monocacy (3d rate).—In service. Engines in good condition. Boilers to be replaced by partially completed boilers sent from Mare Island navy-yard to the Asiatic Station, to be put in at Shanghai. ($20,000.)

Montauk (iron-clad).—In good condition. Ready for service. Stores and outfit. ($2,000.)

Monterey (tug).—In service. Repairs incident to continuous service. ($2,000.)

Nahant (iron-clad).—Well preserved. Ready for service. Stores and outfit. ($2,000.)

Nantucket (iron-clad).—In good condition. Ready for service. Stores and outfit. ($2,000.)

New York (1st rate).—Requires new machinery and new boilers (now on hand), to be erected on board the vessel at the New York navy-yard. ($60,000.)

Nipsic (3d rate).—In service. In good condition.

Nina (tug).—In service. In good condition.

Omaha (2d rate).—Thorough overhauling and repairs, with new boilers, just completed at the Portsmouth (N. H.) navy-yard.

Ossipee (3d rate).—In service. In good condition.

Palos (4th rate).—In service. In fair condition.

Passaic (iron-clad).—In good condition.

Pensacola (2d rate).—Undergoing thorough overhauling and repair at the Norfolk navy-yard. ($30,000.)

Pilgrim (tug).—In service. Repairs incident to continuous service. ($1,000).

Pinta (tug).—In service. In good condition.

Powhatan (2d rate).—In service. Boilers in bad condition. Requires thorough overhauling and repairs, with new boilers (material on hand). ($60,000.)

Quinnebaug (3d rate).—In service. Boilers in poor condition. Will shortly require to be thoroughly overhauled and repaired, with new boilers. ($75,000.)

Ranger (3d rate).—In service. In fair condition.

Rescue (tug).—Small repairs required. ($500.)

Richmond (2d rate).—In service. Requires general overhauling and repairs, with new boilers. ($45,000.)

Rocket (tug).—In service. In good condition.

Saugus (iron-clad).—Requires new boilers and machinery repaired to fit for service. ($40,000.)

Shenandoah (2d rate).—In service. In good condition.

Speedwell (tug).—In service. In good condition. Repairs incident to continuous service. ($2,000.)

Standish (tug).—In service. In good condition.

Swatara (3d rate).—In service. Will soon have to be generally overhauled and repaired, with new boilers. Boilers being constructed. ($40,000.)

Tallapoosa (4th rate).—Will require to have engines, &c., overhauled and put in order. ($5,000.)

Tennessee (1st rate).—In service, but undergoing repair at the New York navy-yard. Should soon have thorough overhauling and repairs, with new boilers. ($85,000.)

Trenton (2d rate).—In service. In good condition.

Triana (tug).—Requires thorough repair and new boilers. ($15,000.)

Vandalia (2d rate).—Being thoroughly overhauled and repaired, with new boilers put in, at the Portsmouth (N. H.) navy-yard. ($30,000.)

Wachusett (3d rate).—In service. Requires thorough overhauling and repairs, with new boilers. ($75,000.)

Wabash (1st rate).—Requires to be thoroughly overhauled and repaired, with new boilers (now on hand), ($30,000), to fit for sea-service.

Wyandotte (iron-clad).—Ready for service.

Yantic (3d rate).—In service. In good condition.

DOUBLE-TURRETED MONITORS.

Miantonomoh (3d rate).—In good condition.

Amphitrite, *Puritan*, *Terror* (3d rates).—Work progressing satisfactorily under contracts for completion of the machinery, &c.

Monadnock (3d rate).—Boilers completed at Mare Island navy-yard. To build engines and fit for sea-service. ($210,000.)

U. S. S. NEW YORK.

I beg to call particular attention to the U. S. S. New York, now upon the stocks, partially completed, at the New York navy-yard. While it would probably not have been judicious to begin the construction of such a vessel in the present progress of improvement in naval architecture, yet it is certainly a wise and economical measure to complete what would be really a desirable vessel for our Navy in its present condition, in value far beyond the comparatively small amount now necessary to finish her. The engines, boilers, &c., are now on hand, and only require to be erected and connected on board. If they are not used in her they will probably have to be sacrificed, as they are not adapted for use in any vessel which the Department possesses or would now build.

PERSONNEL OF THE ENGINEER CORPS.

I desire particularly to call attention to the inadequate numbers of passed assistant and assistant engineers, as provided by law, viz, 60 of the former and 40 of the latter.

The difficulties arising from this source become steadily more embarrassing; and as vessels of large power are being built, with the prospect of others to be constructed in the near future, these officers, who have already had their fair percentage of sea duty, must be ordered to sea at shorter intervals than the customs of the service exact for officers of equal age in other branches.

In September of this year, there were 166 officers of these grades, of whom 85 were attached to vessels in commission. There were 33 on shore duty, and 19 at the Naval Academy and teaching mechanical engineering at colleges, apparently leaving 29 for reliefs, &c. But of this latter number, 4 were sick, 4 more on sick leave, and 6 on leave of absence, really leaving only 15 awaiting orders and available for all contingencies. For the number of vessels in commission at the present time, the efficient officering of the engine department requires at least 80 passed assistant and assistant engineers. To keep this number afloat without an undue percentage of sea service will require an increase in the number allowed by law to at least 160, which I earnestly but respectfully recommend.

Another reason for this recommendation is, that the present system of education at the Naval Academy (according to which all the cadets are taught the same branches, irrespective of the duties to which their corps selections will call them) can never make them efficient specialists; and, in the inevitable absence of specially trained assistant engineers, the number of this grade should be increased, so that the juniors, with general nautical knowledge, may be sent to sea in company with older men of their grade, whose experience and education better fit them for their duties, and from whom the juniors may learn more of their particular profession.

PASSED ASSISTANT ENGINEERS.

Eloquent reference has frequently been made by my predecessors and by several honorable Secretaries of the Navy to the peculiar hardships under which the passed assistant engineers labor in consequence

of their delayed promotion. The justice of their request to Congress for a slight quinquennial increase of pay as a partial compensation becomes every year more apparent, and I most earnestly recommend their claim.

ESTIMATES OF APPROPRIATIONS.

I have the honor to submit herewith the annual estimate of this Bureau for the fiscal year ending June 30, 1886.

The small sum for printing which I have added to the ordinary estimates is for the purpose of continuing the publication of such reports made by experimental boards appointed by the Bureau as contain information of interest to the engineering profession.

This experimental work is ordinarily done without expense to the Government, at the cost of the persons desiring devices or methods tested. It is conducted on a scale sufficiently large to give results directly applicable in practice. The data is original and often valuable in illustrating some mooted point in engineering. The publication of it has been very acceptable to the profession, and the several issues have been sought for with such eagerness that the numbers of most of them are exhausted.

I venture to hope, in the interests of the profession, which this Bureau in some measure represents, that this moderate request may be granted.

Very respectfully,

CHAS. H. LORING,
Chief of Bureau.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Steam Engineering, Navy Department.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year, ending June 30, 1885.
SALARIES.		
Chief clerk, July 7, 1884	$1,800 00	$1,800 00
To increase the salary to make it equal to the pay of the chief clerks of the other offices of the Executive Departments, viz, $2,250 (submitted)	450 00	....
Chief draughtsman, July 7, 1884	2,250 00	2,250 00
Assistant draughtsman, July 7, 1884	1,400 00	1,400 00
One assistant draughtsman (submitted)	1,200 00	....
One assistant draughtsman (submitted)	1,000 00	....
One clerk of class two, July 7, 1884	1,400 00	1,400 00
To promote to class three, as the duties performed are as important as those to which clerks of class three are appointed in the other Bureaus and Executive Departments (submitted)	200 00	....
One clerk of class one, July 7, 1884	1,200 00	1,200 00
To promote to class two, as the duties performed by this clerk are as important as those to which clerks of class three are appointed in the other Bureaus and Executive Departments (submitted)	200 00	....
One clerk of class one, July 7, 1884	1,200 00	1,200 00
One clerk, July 7, 1884	1,000 00	1,000 00
One assistant messenger, July 7, 1884	720 00	720 00
Two laborers, July 7, 1884	1,320 00	1,320 00
	15,340 00	12,290 00

Estimates of appropriations required for the service, &c.—**Continued.**

Detailed objects of expenditure, and explanations.		Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the six months ending December 31, 1884.
CONTINGENT.			
For stationery and miscellaneous items, July 7, 1884		$1,500 00*	(†)
PRINTING.			
For printing reports on valuable experiments made by boards of United States naval engineer officers (submitted)		1,000 00	
CIVIL ESTABLISHMENT.			
Portsmouth, N. H., navy-yard:			
One clerk to chief engineer	$1,400 00		
One store clerk	1,300 00		
Boston, Mass., navy-yard:		2,700 00	
One clerk to chief engineer	1,400 00		
Brooklyn, N. Y., navy-yard:		1,400 00	
One clerk to chief engineer	1,400 00		
One store clerk	1,300 00		
League Island, Pa., navy-yard:		2,700 00	
One clerk to chief engineer	1,400 00		
Washington, D. C., navy-yard:		1,400 00	
One clerk to chief engineer	1,400 00		
One store clerk	1,300 00		
Norfolk, Va., navy-yard:		2,700 00	
One clerk to chief engineer	1,400 00		
One store clerk	1,300 00		
Pensacola, Fla., navy-yard:		2,700 00	
One writer	1,017 25		
Mare Island, Cal., navy-yard:		1,017 25	
One clerk to chief engineer	1,400 00		
One store clerk	1,300 00		
		2,700 00	
STEAM MACHINERY.		17,317 25	$5,000 00
Repairs, completion, and preservation of machinery and boilers, including steam steerers, steam capstans, steam windlasses, &c., in vessels on the stocks, in ordinary, &c.; purchase and preservation of all materials and stores; purchase, fitting, and repairs of machinery and tools in the navy-yards and stations; wear, tear, and repair of machinery and boilers of naval vessels; incidental expenses for naval vessels, yards, and Bureau, such as foreign postages, telegrams, advertising, freights, &c., July 7, 1884		1,000,000 00	500,000 00
CONTINGENT.			
Drawing materials, instruments, &c., for the draughting-rooms, July 7, 1884		1,000 00	500 00
INCREASE OF THE NAVY.			
For steam machinery, boilers, and all the necessary fittings for—			
One cruiser of 4,500 tons (submitted)		350,000 00	
One crusier of 3,100 tons (submitted)		260,000 00	
One dispatch vessel of 1,500 tons (submitted)		175,000 00	
Two heavily-armed gunboats of 1,500 tons each, $165,000 each (submitted)		330,000 00	
One light gunboat of 750 tons (submitted)		77,000 00	
One gunboat of 900 tons (submitted)		90,000 00	
One steel ram (submitted)		500,000 00	
One cruising torpedo-boat (submitted)		15,000 00	
Two harbor torpedo-boats, $12,000 each (submitted)		24,000 00	
One armored vessel of 8,500 tons		700,000 00	
		2,521,000 00	
Steam machinery for two auxiliary steam barks for the Training Squadron (submitted)		20,000 00	
For completion of (partly completed) new machinery, boilers, &c., for U. S. S. New York, at New York navy-yard (submitted)		65,000 00	
For completion and erection of engines, &c.: connect with boilers and make ready for sea service on U. S. S. Monadnock, at San Francisco, Cal. (submitted)		206,000 00	

* Appropriated under "Secretary's office."

† Act approved July 7, 1884.

NAVY DEPARTMENT,
BUREAU OF PROVISIONS AND CLOTHING,
Washington, D. C., November 10, 1884.

SIR: I have the honor to submit a report of the operations of this Bureau for the fiscal year ended June 30, 1884.

STATEMENT OF APPROPRIATION PROVISIONS FOR 1883–'84.

Amount appropriated for the year		$1,100,000 00
Amount transferred from the appropriation provisions to general account of advances on account of expenditures by pay officers abroad during the year	$780,456 06	
Amount expended by the Bureau, as per requisition	319,267 40	
		1,099,723 46
Balance of appropriation on hand at this date		276 54
General account of provisions received and expended for 1883–'84:		
Amount appropriated		1,100,000 00
Amount received for provisions issued to officers' messes		5,068 83
		1,105,068 83
Amount expended by pay officers abroad:		
For commuted rations to officers	$88,218 00	
For commuted rations to crews	380,130 90	
For commuted rations to marines	38,389 20	
For provisions purchased (including water)	309,895 67	
Freight on provisions, labor, and expenses of storehouses	9,030 71	
Total amount expended by pay officers abroad		825,664 48
Amount expended by Bureau:		
For commuted rations to officers	26,342 70	
For commuted rations to crews	4,179 00	
For provisions purchased (including water)	213,875 71	
Freight on provisions, labor, and expenses of storehouses	74,869 99	
Total amount expended by Bureau		319,267 40
Amount of commuted rations stopped on account of sick in hospital and credited to the hospital fund	13,421 10	
Amount due on contract	6,510 00	
		19,931 10
Total amount expended under provisions		1,164,862 98
Total amount appropriated and received		1,105,068 83
Deficiency for 1883–'84, overpayment from general account of advances.		59,794 15
Total expense on provision account, including balances expended and estimated losses:		
For commutation of rations:		
To officers, paid by pay officers abroad	$88,218 00	
To officers, paid by Bureau	26,342 70	
Total for 381,869 rations, at 30 cents		114,560 70

Total expense on provision account, &c.—Continued.		
To enlisted men, paid by pay officers abroad	$380,130 90	
To enlisted men, paid by Bureau	4,179 00	
To marines, paid by pay officers abroad	38,389 20	
To crews and marines, total for 1,408,997 rations, at 30 cents		$422
Amount credited to hospital fund on account of sick in hospitals, 44,737 rations, at 30 cents		13
Total amount paid for 1,835,603 rations		550,6
Cost of rations in kind issued to enlisted men and marines, 1,876,545 rations, at 30.9245 cents each		580,3
Loss on rations issued, 5 per cent. on $580,312.33 (estimated)		29,0
Amount paid for water purchased for cooking and drinking		13,6
Amount paid for freight, labor, and expenses of inspections and storehouses		83,
Total expense on provision account		1,257,[illegible]

CLOTHING FUND.

Balance on hand July 1, 1883		344,[illegible]
Amount transferred from general account of advances to the clothing fund, on account of issues on board ships during the fiscal years 1882-'83 and 1883-'84		293,1
Amount received from sales of clothing		6,[illegible]
Total amount received under clothing		643,[illegible]
Amount transferred from the clothing fund to general account of advances, on account of purchases by pay officers during the fiscal years 1882-'83 and 1883-'84	$9,259 78	
Amount expended by the Bureau, as per requisitions	171,809 75	
Total amount expended		181,
Balance on hand July 1, 1884		462
Amount transferred up to this date from the clothing fund to general account of advances, on account of purchases abroad during the fiscal year 1883-'84	$9,056 55	
Cost of clothing issued on board ships during the fiscal year 1883-'84	246,406 07	
		255,
Cost of clothing purchased by pay officers abroad and paid for from general account of advances during the fiscal year 1883-'84	9,704 90	
Amount transferred up to this date from general account of advances to the clothing fund, on account of issues on board ships during the fiscal year 1883-'84	230,671 33	
		240,
Balance due the clothing fund at this date on account of the fiscal year 1883-'84		15

SMALL-STORES FUND.

Amount transferred up to this date from the small-stores fund to general account of advances on account of purchases abroad during the year		5,
Cost of small stores issued on board ships during the year		78,
		83,
Cost of small stores purchased by pay officers abroad, and paid for from general account of advances, during the year	$6,708 03	
Amount transferred, up to this date, from general account of advances to the small-stores fund, on account of issues on board ships during the year	72,400 05	
		79,
Balance due the small-stores fund, at this date, on account of the fiscal year 1883-'84		4,

APPROPRIATION CONTINGENT.

Amount appropriated		$40,000 00
Amount transferred from the appropriation contingent to general account of advances, on account of expenditures by pay officers abroad during the year	$6,313 08	
Amount expended by Bureau, as per requisitions	32,914 32	
		39,227 40
Balance on hand at this date		772 60

CLOTHING.

The system established in 1879 for the manufacture of uniform clothing at the New York navy-yard has been much improved during the past year, under the immediate supervision of Paymaster G. H. Read, U. S. N., resulting in the production of better fitting and more perfectly made garments, in the reduction of the cost of uniforms for officers and enlisted men, and economy in Government expenditures.

Some of the advantages of the present system of manufacture are the following:

The Government makes no allowance for clothing, yet it is necessary for the Department to supply uniform clothing and material of regulation pattern to enlisted men or officers of the Navy, as they may be required.

Each officer and man being at liberty to procure his uniform outfit in such manner as he may prefer, it is for the interest of each to procure his uniform at the lowest price possible, and, as there is no compulsion to purchase from the Government, the inducements to draw clothing from the Government must be found in the convenient method of supply, in the superior quality of each article furnished, and its moderate cost. Otherwise, if the articles are not of superior quality, and the other inducements do not exist, the clothing will, to a great extent, be rejected, deteriorate from age, and finally be condemned and sold as unfit for issue, at great loss.

Such was the experience of the Department under the former system of letting out the work of manufacturing uniforms to jobbers.

The saving to the Government and the advantage to the service resulting from the present system of manufacture warrant the Department in perfecting and extending it.

PROVISIONS.

The Board appointed to consider various questions concerning the Navy ration and the facilities for cooking on board vessels of war recommended certain changes, similar to those which this Bureau has already made for the vessels composing the training squadron. The subject having been referred by you to this Bureau, a new ration table has been prepared, embracing a number of articles of food admissible under the law, in addition to those at present in use, and which adds materially to the variety of the Navy ration. Most of these additional articles are such as are produced in this country, and packed for preservation in a peculiar manner.

The importance of supplying these articles for sea use perfectly sound and of good quality cannot be overestimated, for upon them largely depend the health and comfort of the enlisted men in the Navy.

To secure the freshest and best quality of this class of goods it is desirable to procure them from skilled and responsible packers, under a

guarantee that they will keep for a stipulated length of time. ' embrace such articles as butter, brawn, canned roast beef, mutton, h bacon, canned vegetables, and salt fish, and other articles of like character.

To maintain such a ration as is now proposed, the class of arti mentioned above should be packed in the United States especially for naval use and supplied to our foreign squadrons at regular inter of two or three months, and not to be procured abroad, as provisi are procured in bulk, except in case of necessity and always for i diate consumption.

The deterioration and condemnation of provisions unfit for issue re largely from the purchase of inferior articles abroad, and the syst created by law of purchasing yearly supplies under contract. The system is wasteful, inconvenient, and expensive, and under it the Government seldom procures these supplies direct from the packers. The advantage of procuring supplies direct from the original dealers, or their agents, is demonstrated by the favorable experience of the British navy. In that service the director of naval supplies procures, at his discretion, under his responsibility to the British Admiralty, every article procurable under the appropriation for supplies, which amounts to £5,000,000 annually.

The law requiring the purchase of provisions from the lowest bidder after advertisement is not well adapted to the procurement of canned provisions. Being hermetically sealed, each package cannot be spected. The honesty and responsibility of the packer are, therefore, the best guarantee against the delivery of inferior products. All provisions should be purchased, not periodically, but as the demands of the service require. There can be no reasonable doubt that, if greater latitude in the methods of procuring provisions for our Navy should be conceded to the Navy Department, under the most rigid guards against frauds which Congress can impose, a great saving to the Government would result, and better and fresher food be provided for enlisted men of that service. These remarks apply with special force to the purchase of beans, peas, bacon, ham, tea, molasses, and all sim articles of food.

That provisions may be furnished in proper quantities and prop tions for our squadrons abroad, capable and experienced pay offi should be detailed at the most accessible ports, to draw from the Ui States in advance such stores as may be needed for the squadr s the several stations for the period of three months, and to receive and distribute them. By means of the direct and rapid modes of communicating with distant ports in different parts of the world, now available, supplies could be furnished with certainty and regularity from this country, and large sums, now expended abroad, would be distributed among our own merchants.

The means of preparing and cooking food on board our vessels of v have heretofore been inadequate. The method of cooking has been l ited almost entirely to boiling. The cooks have been unskillful. The intervals of serving meals have been too short. While dinner has served at 12 o'clock noon, breakfast has been served at 8 o'clock a. m., and supper at 4 o'clock p. m., leaving an interval of sixteen hours during which enlisted men are not provided with a meal, although the food supply is sufficient. Dr. Pavy in a long essay on practical dietetics (1881) uses this language: "Next to the quantity and quality of food, attention must be given to the mode of taking it. That the food should be taken with regularity, and at proper periods, is almost as necessary

for the maintenance of health and a vigorous state of the energies as that it should be of a proper nature and in proper quantity."

Surgeon Kershner, U. S. N., in his report to the Bureau of Medicine and Surgery, printed in 1878, calls attention to the following in regard to the manner of furnishing meals to the enlisted men:

1. They get but one hot and sufficiently varied meal a day (dinner).

2. They get a cold breakfast, consisting of but a single food element, dry bread. Fats are naturally called for at breakfast to start the machinery of digestion.

3. All three of their meals are crowded into about nine hours, leaving fifteen hours of fasting. Growing boys should be fed often, and the younger they are the oftener they should be fed.

4. The large quantity of coffee consumed daily, without a corresponding supply of solid food to accompany it, is likely to give rise to atonic dyspepsia.

5. Is it not possible to improve the present mode of cooking the ration, so that more of its fatty parts, now wasted as "slush," may be saved as food, and greater variety in form be obtained? The French Navy appears to have met with fair success in this direction.

On every large ship of war an experienced baker should be employed, and means should be provided for baking breads and meats.

The present practice of employing enlisted men, entirely ignorant of cooking, to act as cooks for separate messes should be abandoned, and competent men for that special duty enlisted, and wages commensurate with the services they render should be paid from the appropriation "Pay of the Navy."

The custom of commuting a ration for the mess cooks or caterers, for their individual benefit, is not only unjust to the rest of the mess, but is not warranted by law.

The ration regulations lately issued by this Bureau, with your approval, are intended to change some of these practices, but the subject is one of sufficient importance to enlist the active co-operation of the entire service.

The former regulation of the Bureau allowing a surrender of a portion of the ration, resulted in the loss to the Government of large quantities of good provisions, which were surrendered over and over again until they were condemned as unfit for issue.

Nor did the practice in the service at large prove to be as popular as in some quarters it was supposed to be. This is demonstrated by the returns to this Bureau, which show that the portions of the surrendered rations in the entire Navy for the fiscal year 1881–'82 amounted to $59,762.58. Returns for fiscal year 1882–'83 amounted to $53,546.07. For six months, from July 1, 1883, to January 1, 1884, it amounted to only $9,264.51.

These figures prove that neither the necessity nor inclination of the enlisted men rendered the practice advisable, and the order has been rescinded.

TOBACCO.

The Bureau again calls attention to the law which limits the procurement of tobacco to the kind now in use, and recommends a change therein, so that the Bureau shall have authority to purchase such quality of tobacco as the enlisted men who use and pay for the same may prefer.

THE LADY FRANKLIN BAY EXPEDITION.

In fitting this expedition with provisions and clothing this Bureau found on record no adequate specifications by which articles required could be manufactured or purchased.

By correspondence and consultation with the highest authorities on polar expeditions new lists of provisions and clothing were made containing the names of many articles not included in any other lists obtainable, and careful specifications of each article and the manner of packing them were drawn up, printed, and filed in this Bureau for future reference.

The total amount expended for clothing for this expedition was	$63,027 15
Amount issued to officers and men during the cruise	30,225 86
Value remaining on hand	32,801 29
Total amount expended for provisions	105,047 74
Amount issued to officers and men during the cruise	22,326 86
Value remaining on hand	82,720 88

A considerable quantity of these provisions returned have been utilized for the Navy.

Such portions of the clothing and provisions as are not adapted to naval use will be disposed of at public sale, as provided by law.

The principal articles in this list are furs and pemmican.

It is with great satisfaction that the Bureau learns from the commander of the expedition, Commodore W. S. Schley, United States Navy, that the outfit provided by this Bureau proved to be of excellent quality. The pemmican, which is exceedingly difficult to prepare, was promptly furnished by Messrs. Kemp, Day & Co., who also furnished other canned goods of the best quality.

The soups and beef were furnished by McNally, Libby & Co., of Chicago; the numerous other articles were prepared by the extensive grocers, Messrs. Thurber & Co., of New York City.

SALE OF SUPPLIES TO OFFICERS AND MEN.

Under sections 1144, 1145, 1200, 1300, 1363, and 3692 of the Revised Statutes, authority is given to the Subsistence Department to sell to officers and enlisted men such articles as may be designated by the Inspectors-General of the Army, and the amounts received from sales of such commissary stores are exempted from being covered into the Treasury, and it is provided that the money so received shall revert to the general appropriation for use in making other purchases. It would confer great benefits upon the enlisted men and officers of the Navy, if similar privileges should be extended to them, under regulations which might be established by this Bureau with the approval of the Secretary of the Navy.

MARINE PROPERTY ACCOUNTS.

Heretofore the property accounts of the Marine Corps have not been adjusted or examined by the Navy Department.

By the terms of your regulation circulars Nos. 39 and 40 certain money and property accounts of the Marine Corps are to be rendered to this Bureau, and returns of arms and accouterments to be made to the Bureau of Ordnance.

Proper steps have been taken by this Bureau to carry out the provisions of the circulars with regard to the accounts placed under its cognizance.

ACCOUNTS.

PAYMENT OF NAVAL CLAIMS.

By the terms of section 3676 of the Revised Statutes it is made the duty of the Secretary of the Navy to direct the payment of claims appertaining to that service after adjustment by the accounting officers of the Treasury.

Contrary to this provision of law, heretofore such claims have been settled by certificates of those accounting officers, which certificates embrace orders for payment to pay officers of the Navy.

Under your direction the Bureau now receives all certificates of claims adjusted by the accounting officers, registers and forwards them to the pay officers designated to pay them. The system appears to work with satisfaction, and it enables the Secretary of the Navy to exercise a supervision over their payment, which might, in case of doubtful claims involving large amounts, prove to be of great advantage to the Government.

In the opinion of this Bureau all naval accounts should come under the scrutiny of the Navy Department, including those under "Pay of the Navy" and "General account of advances," which now are transmitted directly and only to the accounting officers of the Treasury.

The pay-rolls of the Navy include accounts and receipts for millions of dollars annually. The amounts paid are from appropriations under the control of the Secretary of the Navy. Yet for these vast amounts there are no vouchers transmitted to the Secretary and no record kept of them in the Department from which information pertaining to them can be obtained. This occurs through the operation of a clause in section 3622 of the Revised Statutes, which, it is submitted, should be so modified as to require the scrutiny and supervision of the Secretary of the Navy over all accounts of disbursements under naval appropriations, after the system in practice in the Army, before transmittal to the accounting officers of the Treasury.

THE PAY CORPS.

The total number of pay officers on the active list at the present time is 120, distributed as follows: On sea duty, 39; on shore duty, 50; settling accounts, waiting orders, or on leave, 29; and under suspension, 2. There have been altogether, during the past year, 60 different pay officers on sea duty and 63 on shore duty at home and abroad, thus showing the number of changes of station to have been 34, and illustrating the fact that the number of officers necessary in the corps to make these changes is considerably in excess of the number permanently required on duty, and also in excess of the ultimate limit of the corps to 96 officers, fixed by the act of August 5, 1882.

In the Pay Corps during the year there have been 2 deaths, 2 retirements, and 1 resignation, causing 6 promotions for all grades, and reducing the corps by 5 members, thus leaving the total number of 120 pay officers, as stated above.

This is an excess of 24 officers over the number of 96 to which the corps is ultimately to be reduced under the operation of the law allowing only one promotion for every two vacancies in the three lower grades, and prohibiting new appointments until the above limit is reached. The retirements by age are the only casualties which can be known and counted on, and by these 15 years more must elapse before

the corps can be reduced to the limit fixed by law, which will be reached in June, 1899; and of these 24 retirements, 18 (or three-fourths) occur in the last three years. Meantime promotion in the lower grades is almost at a standstill, but two such promotions having occurred during the year, and justice would seem to require the passage of a law providing for an increase of pay in the grades of passed assistant and assistant paymaster for the periods of the third and fourth five-years service therein. I therefore recommend the passage of such a law.

The total amount of money received and disbursed or remaining unexpended in the hands of the Pay Corps of the Navy during the past year in their varied duties as paymasters, and as the general purchasing agents of the Navy for stores of all kinds, was $17,235,458.70, and the responsibility of pay officers for the provisions, clothing, and other stores handled by them during the year amounted to $3,820,274, making their total pecuniary responsibility amount to $21,055,733, all of which has been accounted for without any loss whatever to the Government.

I herewith submit estimates of appropriations, marked A, B, C, D, and E, for the support of the Bureau for the fiscal year ending June 30, 1886, together with schedules from 1 to 12, inclusive, of proposals received, and statement, numbered 13, of contracts made on account of the Bureau during the fiscal year ended June 30, 1884.

I have the honor to be, very respectfully, your obedient servant,

J. A. SMITH,
Paymaster-General, U. S. Navy.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Provisions and Clothing.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1885.
A.—EXPENSES OF THE BUREAU OF PROVISIONS AND CLOTHING.			
For salary of chief clerk, per act of July 5, 1862 (12 Stat. at L., p. 511, sec. 3)	$1,800 00		
For increase of salary of chief clerk (submitted)	450 00		
For one clerk of class four, per act of July 23, 1866 (14 Stat. at L., p. 208, sec. 8)	1,800 00		
For two clerks of class three, per act of July 23, 1866, (14 Stat. at L., p. 208, sec. 8)	3,200 00		
For one clerk of class three (submitted)*	1,600 00		
For two clerks of class two, per act of July 23, 1866 (14 Stat. at L., p. 208, sec. 8)	2,800 00		
For two clerks of class two (submitted)*	2,800 00		
For three clerks of class one, per act of July 23, 1866 (14 Stat. at L., p. 208, sec. 8)	3,600 00		
For one clerk of class one, per act of March 3, 1883	1,200 00		
For two copyists, per act of March 3, 1883	1,800 00		
For one messenger, per act of March 3, 1883	720 00		
For one laborer, per act of March 3, 1883	660 00		
For one laborer (submitted)*	660 00		
		$23,090 00	$17,580 00

* By a recent order it is made the duty of the Bureau to supervise the money accounts of all pay officers, and for the performance of this duty the additional clerk of class three and two additional clerks of class two are asked for, as their services are necessary to keep up the work of the Bureau. It is also respectfully urged that an additional laborer be allowed the Bureau; the increased work demands his services as a messenger, the messenger being employed the greater portion of his time on clerical work.

Estimates of appropraitions required for the service of the fiscal year, &c.—Continued.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.	Amount appropriated for the current fiscal year ending June 30, 1882.
B.—CONTINGENT EXPENSES OF THE BUREAU.			
For blank books, stationery, and miscellaneous items (submitted)†	600 00		
For furniture, desks, book and file cases, and books for reference (submitted)†	500 00	1,100 00	400 00
C.—PROVISIONS NAVY, BUREAU PROVISIONS AND CLOTHING.‡			
For commutation of rations for 343 naval cadets, 757 officers on sea duty, 401,500 rations, at 30 cents	120 450 00		
Amount paid during last fiscal year ... $114,560.70			
For rations and commutation of rations for 8,250 men and boys and 1,000 marines, 3,376,250 rations, at 30 cents	1,012,875 00		
Amount paid for 1,408,997 commuted rations during last fiscal year ... $422,699 10			
Cost of rations actually issued during last fiscal year, 1,876,545 rations ... 580,312 33			
1,003,011 43			
Cost of each ration issued ... 30.9245			
For commuted rations, stopped on account of sick in hospital and credited to hospital fund	13,500 00		
Forty-four thousand seven hundred and thirty-seven rations, at 30 cents, the amount credited during the last fiscal year ... $13,421 10			
For losses on rations issued, 5 per cent. on $580,312.33	29,015 61		
For water for drinking and cooking on board ships	15,000 00		
Amount expended during last fiscal year ... $13,669 70			
For labor and expenses of inspections	85,000 00	1,275 840 61	550,000 00
Amount during last fiscal year ... $83,900 70			
D.—CONTINGENT, BUREAU OF PROVISIONS AND CLOTHING.			
For freight on shipments, candles, fuel, books and blanks, stationery, advertising, furniture for inspections and pay offices in navy-yards, expenses of naval clothing factory, foreign postage, telegrams, express charges, tolls, ferriage, car tickets, yeomen's stores, iron safes, newspapers, ice, and other expenses not enumerated, per act of July 7, 1884	....	60 000 00	20 000 00
NOTE.—For several years past the freight on provisions has been paid from the appropriation "Provisions," and the freight on all other stores belonging to the Bureau from the appropriation "Contingent." When provisions are to be shipped, other stores belonging to the Bureau are almost invariably shipped at the same time; and thus it becomes necessary to prorate the amount of freight between the two appropriations and to make out two sets of bills. To simplify this, and to obviate the necessity for the double labor, it is recommended that the appropriation be so changed as to pay all freight from the appropriation "Contingent," and that that appropriation be increased to $60,000 from $40,000, the amount appropriated for the current year.			
E.—CIVIL ESTABLISHMENT, BUREAU OF PROVISIONS AND CLOTHING.			
Navy-yard, Boston, Mass.:			
One writer to paymaster	1,017 25		
One writer to inspector	1,017 25		
Navy-yard, New York:			
One writer to inspector	1,017 25		
One writer to paymaster	1,017 25		
One writer to paymaster	939 00		
One writer to naval clothing factory	1,017 25		
Navy-yard, League Island, Pa.:			
One writer to paymaster	1,017 25		
Navy-yard, Washington, D. C.:			
One writer to paymaster	1,300 00		
Navy-yard, Norfolk, Va.:			
One writer to paymaster	1,017 25		
One writer to inspector	1,017 25		
Navy-yard, Mare Island, Cal.:			
One writer to paymaster	1,017 25		
One writer to inspector, per act of July 7, 1884	1,017 25	12,411 50	3,000 00

† The amount allowed from the appropriation for the Navy Department for the contingent expenses of the Bureau is absolutely insufficient to supply its actual requirements, and it is urgently recommended that the amount asked for be appropriated.

‡ The appropriations under C, D, and E are for the first six months of the current fiscal year ending December 31, 1884.

Schedule of proposals for fresh provisions, navy bread, baking, and water received during the fiscal year ending June 30, 1883, *the supplies to be delivered during the fiscal year* 1884.

Names.	Where to be delivered.	Fresh bread.	Fresh beef.	Fresh vegetables.	Navy bread.	Baking flour.	Water.
		Per lb.	*Per lb.*	*Per lb.*	*Per lb.*	*Per bl.*	*Per gal.*
James E. Chase*	Portsmouth, N. H	$0 05.49	$0 09.49	$0 01.50			
B. F. Mugridge	do	08	11.50	01.75			
John Holland	do	06	11.75	01.75			
J. W. Hobbs*	Boston, Mass		13.50	04			
C. A. Flanders	do		15.12½	04.25			
H. P. Stevens	do		17	02.25			
Austin & Graves*	do	06				$1 75	
J. G. Allport & Co	New York, N. Y		10.50	02			
John Hanley*	do		10.25	02			
J. J. Lyons†	do		10.60	02.90			
C. Desmond†	do		11	02.50			
Patrick Sullivan†	do		09¾	01.75			
John Burns†	do	03.50					
James Godfrey†	do	06.50					
Frank Fruin	do	06.50					
J. McNamara*	do	06.25					
E. Treadwell's Son	do					1 17	
C. T. Goodwin & Son*	do					89.50	
John Hartman*	League Island, Pa					1 40	
C. Strohmaier*	do	05.25					
L. S. Boraef*	do		12.50	04			
C. Henizerling	Washington, D. C	03.85					
Koller & Ginzer	do	03.50					
F. G. Alexander	do		09.99	03.25			
B. Charlton & Co*	do	03¾				1 50	
C. C. Carroll*	do		09.75	03			
George Seitz & Son†	do	03.90					
J. B. Kimberly	Norfolk, Va	05.25	10.73	03.75			
George Berry	do		06.85	01.83			
Robert Searles	do		08.45	02½			
F. Dusch	do		06.65	01.70			
J. Gutman*	do		06.13	01.25			
S. Westheimer	do		06.66	01.95			
J. G. Codd & Bro	do		07.10	02.10			
L. Wasserman	do		06.45	01.75			
C. T. Cabler*	do	04.25					
James Reid & Co*	do					2 00	
William Clark*	do						
William Clark*	Fortress Monroe, Va						
J. B. Kimberly*	do	04.25					
C. T. Cabler	do	04.37½					
John S. Bell*	Pensacola, Fla		16	07			
J. O'Neal*	do				06.50		
Moses White*	do	06					
A. Neuman	Mare Island, Cal		14	03.50			
John Faust*	do	05					
J. F. Tobin*	do		10.50	02.75			
California Cracker Co*	do				04.4		
D. T. Brown, jr	do	05.50					
Eclipse Cracker Company	do				04.45		

* Contract awarded. † Informal.

Schedule of proposals for 25,000 *pounds candles, under advertisement dated September* 3, 1883.

A. P. Brown	$0 17¾
J. R. Michael	14.4
Electric Candle Company *	14.24

Schedule of proposals for 35,000 *yards cotton duck, under advertisement dated September* 4, 1883.

	Price per yard.
J. R. Michael *	$0 11
George H. Creed	11.[illegible]
R. A. Robbins	12.10
A. P. Brown	12.5

* The contract was awarded to the Electric Candle Company. Their candles not being equal to the Navy standard, the contract was offered to J. R. Michael, the next lowest bidder, who declined to accept it, and it was finally given to A. P. Brown.

* Contract awarded.

Schedule of proposals for miscellaneous supplies received, under advertisement dated September 29, 1883.

Name.	15,000 pounds evaporated apples, per pound.	50,000 pounds coffee, per pound.	5,000 gallons beans.	5,000 yards Barnsley sheeting.	5,000 pairs calf shoes.	3,000 pairs kip shoes.
	Cents.	*Cents.*	*Per gall.*	*Cents.*	*Per pair.*	*Per pair.*
J. W. Buker	*17.4			†65		
R. A. Robbins		13.24	‡$0 49½ §$0 50⅝	99		
J. R. Michael				96		
A. P. Brown	20	*12¼	*47	98		
Woodward and Lothrop				‖81 †*60		
Henry Smith				65		
H. H. Tobey				†65½		
R. M. Masterton		12.89				
J. B. Overton		12.98				
George H. Creed				89		
H. K. & F. B. Thurber ¶		13¼				
J. Freeman & Co*					*$2 24¾	$2 24¾

Name.	10,000 pairs woolen socks.	3,000 neckerchiefs.	5,000 spools cotton.	3,000 pocket handkerchiefs.	25,000 pounds candles, per pound.
	Cents.	*Each.*	*Per spool.*		*Cents.*
J. R. Michael **	39	$1 05	*$0 04	$0 09	
A. P. Brown					17½
B. Y. Pippey & Co	*30.74	1 20			
Woodward & Lothrop				(††)	
H. H. Tobey **	31.99	1 10	**04	12.99	
Manhattan Oil Company					*15
George H. Creed	37½	*98	04½	*08	15.6

* Contract awarded. ‡ Crop 1882. ‖ Duty paid. ** Tie bids, decided by lot.
† In bond. § Crop 1883. ¶ Informal. †† From $1.12½ to $1.92 per dozen.

Schedule of proposals for miscellaneous supplies under advertisement of October 22, 1883.

Name.	500 barrels beef.	500 barrels pork.	75,000 pounds preserved beef.	30,000 pounds rice.	150,000 pounds sugar.	5,000 gallons molasses.	5,000 gallons vinegar.	5,000 yards cloth for trousers.
	Per bbl.	*Per bbl.*	*Per lb.*	*Per lb.*	*Per lb.*	*P'r gall.*	*P'r gall.*	
B. Y. Pippey & Co								$2 29
David Babcock & Co	$17 79	$15 38	$0 12.89					
J. W. Buker				$0 06.90		*$0 54		
J. R. Michael	16 94	14 10	*12.49	06.7	$0 08.1	67		2 42
A. P. Brown	*15 50	* 13 40	16½		08¼	63	$0 17	
H. K. Thurber	19 19	18 19	13.49	06.2	*08.8	58½	13.99	
R. M. Masterton				06.70	08.14	59½		
A. H. Welch								2 23
H. W. Pitkin								2 44.9
Lewis Brothers & Co								*1 87
John Schlegel							9.25	
New Albany Woolen Mills								1 95
W. S. Abbey, jr						58		
R. A. Robbins	half, 8 73 whole, 16 73	half, 8 47 whole, 16 22		06.44	08.23	59.4		

* Contract awarded. † Informal.

Schedule of proposals for miscellaneous supplies, &c.—Continued.

Name.	2,000 yards cloth for caps.	2,000 yards thin flannel.	25,000 yards 6-4 11-oz. flannel.	5,000 yards 3-4=3½ oz. flannel.	30,000 yards cotton duck.	1,000 pairs boots.	5,000 blankets.	150,000 pounds S. W. soap.
		Per yd.		*Cents.*	*Per yd.*	*Per p'r.*	*Each.*	*Per lb.*
B. Y. Pippey & Co	$2 39	*$0 47	$1 04	49	$0 11.92		$2 49	$0 04.75
J. W. Buker					12.60			
J. R. Michael	2 58	59	1 29	63	11.83	*$3 73	2 29½	04.24
A. P. Brown			1 27½					06¼
F. A. McKeone								03.99
H. K. Thurber								*03.74
S. M. Milliken			1 14.9		11.99		2 39	
Thomas Kent		49	1 03.9	*44				
John Welch					11.93			
A. H. Welch			*98½					
H. W. Pitkin	2 39½							
Lewis Brothers & Co	*2 00		1 12					
S. T. Willets								04.7
J. Freeman & Co						3 99		
George H. Creed					*11.4			
J. & L. Seasongood & Co			1 15					
T. A. Ashburner							2 30¾	
New Albany Woolen Mills							*2 11¼	
Lorenzo Maynard			1 09¼					
Colgate & Co								04.29
R. A. Robbins					11.88		2 94	04.12

* Contract awarded.

Schedule of proposals for clothing and small stores received under advertisement dated January 21, 1884.

Names.	10,000 pairs woolen socks.	3,000 scissors.	1,000 razor strops.	3,000 shaving brushes.	5,000 cakes shaving soap.	5,000 scrub brushes.	5,000 shoe brushes.
	Per pair.	*Each.*	*Each.*	*Each.*	*Each.*	*Each.*	*Each.*
J. H. Walker		$0 28¾	$0 21.7	$0 09½	$0 08.2	$0 16½	$0 24.9
R. C. Gwynn						15	*19
R. A. Robbins		29	19	*7.9	‡93	*13	21.7
J. J. Walton		49	26	12½	07.3		
B. Y. Pippey & Co	*$0 29⅝	30				19	25
George H. Creed	35	*25	20½	8	08	15	21
J. R. Michael	31	o.s. 15 n.s. 27	*18	9	*04	15	24

Names.	3,000 wisp brooms.	10,000 dozen D. E. buttons.	3,000 dozen pearl buttons.	2,000 fine combs.	5,000 coarse combs.	8,000 forks.	5,000 boxes blacking.
	Each.			*Each.*	*Each.*	*Each.*	*Each.*
J. H. Walker						$0 02⅝	$0 03½
R. C. Gwynn	*$0 10			$0 04½	$0 05.9		03
R. A. Robbins	11	†$1 65	$0 92	§6 80	§6 30	*02.4	04.1
J. J. Walton		‡9	‡10			02.85	04.1
B. Y. Pippey & Co							
George H. Creed	12.8	‡2	11½	05.8	07	02.6	03.8
J. R. Michael	13	*†1 28	*82	*§6 00	*§5 88	02.5	*02.9

* Contract awarded. † Great gross. ‡ Per dozen. § Per gross.

Schedule of proposals for 150,000 *pounds tobacco, under Bureau's advertisement dated February* 19, 1884.

	Per pound.
Wm. Buchanan	$0 32.99
*P. H. Mayo & Bro	40
P. Lorillard & Co	27
C. W. Spicer	29$\frac{5}{8}$

Owing to a misunderstanding of some of the bidders, second bids were called for, with the following result:

	Per pound.
Wm. Buchanan	$0 32.99
P. Lorillard*	25
C. W. Spicer	29$\frac{5}{8}$

Schedule of proposals for twenty-five thousand (25,000) *pounds pickles, received under Bureau's circular letter dated March* 3, 1884.

	Per pound.
Rowland A. Robbins	$0 07$\frac{18}{100}$
Thurber, Whyland & Co	07[illegible]
Alart & McGuire	07$\frac{5}{8}$
F. Foehrenbach & Co	06$\frac{3}{4}$
J. R. Michael	07
Austin P. Brown	10$\frac{1}{2}$
J. W. Buker*	06$\frac{65}{100}$

Schedule of proposals for 10,000 *black silk neckerchiefs, under advertisement dated March* 5, 1884.

Names.	Duty paid.	In bond.	Remarks.
	Each.	*Each.*	
R. A. Robbins	$0 96.88	....	Informal.
J. R. Michael	83.74	$0 64	
J. W. Buker	81	....	
William Campbell	....	8.50*	Informal.
George H. Creed	83	....	

* Per dozen.

Bids for the above were afterwards called for *in bond*, to be opened on March 22, which are given below:

Names.	Duty paid.	In bond.	Remarks.
	Each.	*Each.*	
J. R. Michael	....	$0 57$\frac{1}{2}$	
J. W. Buker	....	57$\frac{1}{4}$*	
George H. Creed	....	63	

* Contract awarded.

Schedule of proposals for miscellaneous supplies, received under advertisement dated April 28, 1884.

	50,000 pounds candles.	10,000 spools cotton.
	Per pound.	*Each.*
J. R. Michael	$0 14.19	*$0 03$\frac{11}{12}$
Manhattan Oil Company	†14	....
R. G. Mitchell*	†14	....

* Contract awarded. † Tie bids, awarded by lot.

* Contract awarded.

Schedule of proposals for 50,000 *pounds butter, under Bureau's letter dated May* 16, 1884.

	Per pound.
Simpson, McIntire & Co	$0 30
Hunter, Walton & Co	31½
W. I. Young & Co*	27¾

Schedule of proposals for Navy supplies, under Bureau's advertisement dated May 24, 1884.

Names.	30,000 yards ¾ 11 ounce flannel.	5,000 pairs calf shoes.	3,000 pairs kip shoes.	5,000 pairs woolen socks.
	Per yard.	*Per pair.*	*Per pair.*	*Per pair.*
B. G. Openheim*	....	$2 22	$2 19	....
J. R. Michael	....	2 28	†2 18	....
J. Freeman & Co	....	2 23	2 47	....
R. A. Robbins	$0 93	....	....	....
J. W. Buker	....	2 26	2 38	....
A. P. Brown	†0 89	†2 22½	2 22½	†$0 28
B. Y. Pippey & Co	0 94	....	....	0 28$\frac{4}{10}$
Thomas Kent	0 93	....	....	....

* Informal. † Contract awarded.

Statement of contracts made by the Bureau of Provisions and Clothing for and in behalf of the Navy Department during the fiscal year ending June 30, 1884.

Name.	Date.	Articles contracted for.	Price.	Where to be delivered.
	1883.			
Geo. Seitz & Son	May 23	Fresh bread..........per pound..	$0 04	Washington, D. C.
G. F. Swift & Co	May 24	Fresh beef..........do....	06½	Do.
Do	May 24	Vegetables..........do....	02¾	Do.
B. Charlton & Co	May 29	Baking bread, per barrel of flour ...	1 50	Do.
James Reid & Co	June 4	......do..........do ...	1 85	Norfolk, Va.
Frank Dusch	June 4	Fresh beef..........per pound..	11 80	Do.
Do	June 4	Vegetables..........do....	04½	Do.
L. S. Boraef	June 4	Fresh beef..........do....	12¾	League Island, Pa.
Do	June 4	Vegetables..........do....	04	Do.
John Hanley	June 4	Fresh beef..........do....	08¾	New York, N. Y.
Do	June 4	Vegetables..........do ...	01½	Do.
E. Treadwell's Son	June 4	Baking bread, per barrel of flour ...	93	Do.
Austin & Graves	June 4	......do..........do ...	1 75	Boston, Mass.
Do	June 4	Fresh bread..........per pound..	06	Do.
J. W. Hobbs	June 4	Fresh beef..........do....	14	Do.
Do	June 4	Vegetables..........do....	04½	Do.
James E. Chase	June 5	Fresh beef..........do ...	12	Portsmouth, N. H.
Do	June 5	Vegetables..........do....	02	Do.
Do	June 5	Fresh bread..........do ...	08	Do.
Wm. Clark	June 5	Water..........per gallon..	01	Norfolk, Va.
Do	June 5	......do..........do ...	01	Fortress Monroe, Va.
J. McNamara	June 6	Fresh bread..........per pound..	04½	New York, N. Y.
C. Strohmaier	June 6	......do..........do....	04½	League Island, Pa.
J. B. Kimberley	June 7	......do..........do....	05$\frac{45}{100}$	Norfolk, Va.
W. H. Kimberley	June 7	......do..........do....	05½	Fortress Monroe, Va.
Moses White	June 8	......do..........do....	06	Pensacola, Fla.
John S. Bell	June 8	Fresh beef..........do....	15	Do.
Do	June 8	Vegetables..........do....	05	Do.
J. O'Neal	June 8	Navy bread..........do....	05	Do.
J. F. Tobin	June 16	Fresh beef..........do....	07$\frac{9}{10}$	Mare Island, Cal.
Do	June 16	Vegetables..........do ...	02$\frac{7}{10}$	Do.
John Faust	June 16	Fresh bread..........do ...	02¾	Do.
John Hartman	June 16	Baking bread, per barrel of flour ...	1 40	League Island, Pa.
California Cracker Company.	June 18	Navy bread..........per pound..	04$\frac{4}{10}$	Mare Island, Cal.
Woodward & Lothrop.	Nov. 1	Barnsley sheeting, 5,000 yards, per yard.	60	New York, N. Y.
Manhattan Oil Company.	Nov. 7	Candles, 2,500 pounds...per pound..	15	Do.
George H. Creed	Nov. 10	Neckerchiefs, 3,000..........each..	98	Do.
Do	Nov. 10	Handkerchiefs, 3,000..........do ...	08	Do.
B. Y. Pippey & Co.	Nov. 10	Woolen socks, 10,000 pairs.per pair..	30$\frac{74}{100}$	Do.
Austin P. Brown	Nov. 12	Coffee, 50,000 pounds ...per pound..	12½	Do.
Do	Nov. 12	Beans, 5,000 gallons ....per gallon..	47	Do.
J. Freeman & Co	Nov. 13	Calf shoes, 5,000 pairs ....per pair..	2 24½	Do.
Do	Nov. 13	Kip shoes, 3,000 pairs..........do....	2 24¾	Do.

* Contract awarded.

Statement of contracts made by the Bureau of Provisions and Clothing, &c.—Continued.

Name.	Date.	Articles contracted for.	Price.	Where to be delivered.
	1883.			
J. W. Buker	Nov. 20	Evaporated apples, 15,000 pounds, per pound.	17 4/10	Do.
J. R. Michael	Nov. 28	Preserved beef, 75,000 pounds, per pound.	12 48/100	Do.
Do	Nov. 28	Boots, 1,000 pairs.........per pair..	3 73	Do.
B. Y. Pippey & Co.	Nov. 28	Thin flannel, 2,000 yards..per yard..	47	Do.
Lewis Brothers & Co.	Nov. 28	Cloth for trousers, 5,000 yards, per yard.	1 87	Do.
Lewis Brothers & Co.	Nov. 28	Cloth for caps, 2,000 yards per yard..	2 00	Do.
H. K. Thurber	Nov. 29	Vinegar, 5,000 gallons...per gallon..	13 98/100	Do.
Do	Nov. 29	Rice, 30,000 pounds ....per pound..	06⅜	Do.
Do	Nov. 29	Sugar, 150,000 pounds ....do....	08 8/100	Do.
Do	Nov. 29	S. W. soap, 150,000 pounds....do....	03 74/100	Do.
Thomas Kent	Nov. 30	Flannel, ¾ 11-ounce, 5,000 yards, per yard.	44	Do.
New Albany Woolen Mills.	Dec. 4	Blankets, 5,000...............each..	2 11½	Do.
A. H. Welch	Dec. 5	Flannel, ¾, 2,500 yards ...per yard..	98½	Do.
Austin P. Brown	Dec. 7	Beef, 500 barrels........per barrel..	15 59/100	Do.
Do	Dec. 7	Pork, 50C barrels ....do....	13 40/100	Do.
J. W. Buker	Dec. 8	Molasses, 5,000 gallons..per gallon..	54	Do.
Geo. H. Creed	Dec. 8	Cotton duck, 30,000 yards..per yard..	11 48/100	Do.
	1884.			
Geo. H. Creed	Feb. 16	Scissors, 3,000 ....each..	25	New York, N. Y.
J. R. Michael	Feb. 19	Razor strops, 1,000 ....do....	18	Do.
Do	Feb. 19	Shaving soap, 5,000 cakes.....do....	04	Do.
Do	Feb. 19	D. E. buttons, 10,000 dozen, per gr. gross.	1 28	Do.
Do	Feb. 19	Pearl buttons, 3,000 dozen, per gross.	82	Do.
Do	Feb. 19	Fine combs, 2,000 ....per gross..	6 00	Do.
Do	Feb. 19	Coarse combs, 5,000 ....do....	5 88	Do.
Do	Feb. 19	Blacking, 5,000 boxes .. ..each..	02 9/10	Do.
B. Y. Pippey & Co.	Feb. 23	Woolen socks, 10,000 pairs per pair..	29⅝	Do
R. A. Robbins	Feb. 25	Shaving brushes, 3,000.......each..	07 9/10	Do.
Do	Feb. 25	Scrub brushes, 5,000 ....do....	13½	Do.
Do	Feb. 25	Forks, 3,000 ....do....	02 4/10	Do.
R. C. Gwynn	Feb. 27	Shoe brushes, 5,000...........do....	19	Do.
Do	Feb. 27	Wisp-brooms, 3,000...........do....	10	Do.
J. W. Buker	Mar. 17	Pickles, 25,000 pounds..per pound..	06 58/100	Do.
Do	Mar. 31	B. S. neckerchiefs, 10,000 (bond), each.	57½	Do.
J. R. Michael	May 16	Spool cotton, 10,000 ....each..	03 11/12	Do.
R. G. Mitchell	May 17	Candles, 50,000 pounds .per pound..	14	Do.
P. Lorillard & Co.	May 19	Tobacco, 150,000 pounds ......do....	25	Do.
W. I. Young & Co.	May 31	Butter, 50,000 pounds ....do .	27½	Do.
J. R. Michael	June 11	Kip shoes, 3,000 pairs ....per pair..	2 18	Do.
A. P. Brown	June 20	Flannel, ¾-ounce, 30,000 yards, per yard.	89	Do.
Do	June 20	Woolen socks, 5,000 pairs per pair..	28	Do.
Do	June 20	Calf shoes, 5,000 pairs ....do....	2 22½	Do.

No. 10.—MARINE CORPS.

HEADQUARTERS U. S. MARINE CORPS, COMMANDANT'S OFFICE,
Washington, D. C., October 3, 1884.

SIR: I have the honor to submit my annual report of the condit of the United States Marine Corps.

On October 1, 1884, there were 1,962 enlisted men in the Corps, 950 of whom were on board ships in commission, and 1,012 doing duty at the several shore stations.

During the past year there have been 893 enlistments, 140 re-enlistments, 16 enlistments from the Army, 398 discharges, 21 deaths, and 571 desertions. One major, two captains, and one first lieutenant on the "active list," and one first lieutenant on the "retired list" have died since the date of my last report. One captain has ben retired, and five second lieutenants have been appointed, to fill vacancies, from the graduates of the Naval Academy.

I renew my recommendation that the number of second lieutenants may be increased to thirty, as provided by section 1596, Revised Statutes. By your direction the estimates have been made for that number.

The inspections made at the posts, and of guards of vessels, are more than ever highly satisfactory, and reflect much credit upon the officers and enlisted men.

I urgently renew my recommendations that Congress may authorize an increase of appropriations for more privates, the present number, 1,500, being inadequate.

By your direction the detachment serving at the navy-yard, Pensacola, Fla., was withdrawn in May last as a measure of precaution, fearing another outbreak of yellow fever. Another detachment can be sent there whenever the Department thinks proper to so order.

The troops are well quartered, except at Norfolk, Va., where new barracks are urgently required. As stated in my last report, a suitable building (not needed for other purposes) at the Norfolk navy-yard can easily be converted into an excellent barrack at an estimated cost (prepared by the civil engineer) of $12,350. This item was inserted in the sundry civil bill at the last session of Congress, and passed the Senate, but failed to pass the House of Representatives. I trust it may be favorably considered at the next session.

There are no quarters for officers at Norfolk, Va., and they are forced to live at long distances from the men. An excellent site can be had in the navy-yard upon which four inexpensive houses could be built at a cost of $24,000.

In justice to the officers of the corps some increase of the higher grades should be made, which would, at the same time, not increase the whole number of officers allowed by law, but would distribute them to better advantage. Promotion in the higher grades is almost at a standstill; and from present appearances some of the captains will never rise to be majors. An excellent bill was presented to Congress

some time since which, if it had become a law, would remedy all difficulties. It should be renewed, and I trust the Department may consider it favorably.

Regulations defining the duties of officers and men are much needed, and those drawn up by a recent board, I trust, may receive the approval of the Department.

The usual estimates for the support of the Corps were forwarded to the Navy Department on the 27th September last, and on the 2d instant.

Very respectfully, your obedient servant,

C. G. McCAWLEY,
Colonel Commandant,
United States Marine Corps.

Hon. WM. E. CHANDLER,
Secretary of the Navy, Washington, D. C.

UNITED STATES MARINE CORPS,
QUARTERMASTER'S OFFICE,
Washington, D. C., September 10, 1884.

SIR: I respectfully transmit herewith the annual "Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the quartermaster's department of the Marine Corps."

These estimates vary from those submitted for fiscal year ending June 30, 1885, as follows:

Clothing is reduced $5,056, in consequence of the cost of material for manufacturing purposes being less.

Repair of barracks is increased $5,000, because it is found that the improvements and repairs absolutely required at the several marine barracks cannot be made upon the present sum appropriated.

The sum of $4,500 is asked under the head of "hire of quarters," to provide quarters for officers serving with troops, where there are no public quarters, &c.

This sum was not embraced in the annual estimates submitted for fiscal year ending June 30, 1885, but was submitted in a supplemental estimate for that year, dated January 5, 1884.

The aggregate amount asked for the fiscal year ending June 30, 1886, is $264,848.56, being $65 less than the amount asked for fiscal year ending June 30, 1885.

I am, very respectfully, your obedient servant,

WM. B. SLACK,
Quartermaster, Marine Corps.

The COLONEL COMMANDANT,
United States Marine Corps, Headquarters.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the quartermaster's department, United States Marine Corps.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.
PROVISIONS.		
For 1,000 non-commissioned officers, musicians, privates, and washerwomen, 365 days, at one ration per day, is 365,000 rations, at 19 cents per ration....	$69,350 00	
For difference between the cost of rations at 19 cents and commutation at $1 for one enlisted man employed as clerk to colonel commandant, 365 days, is 365 rations, at 81 cents per ration, is....	295 65	
For difference between the cost of rations at 19 cents and commutation at 75 cents for eight enlisted men employed as clerks and messengers, in commandant's, adjutant and inspector's, paymaster's, and quartermaster's offices, Washington, D. C., and assistant quartermaster's offices, Philadelphia, Pa., 365 days, is 2,920 rations; at 56 cents per ration, is....	1,635 20	
For difference between the cost of rations at 19 cents and commutation at 50 cents for three enlisted men, employed as above, 365 days, is 1,095 rations, at 31 cents per ration, is....	339 45	
		$71,620 30
NOTE.—Commutation in lieu of rations in kind at the rate of $1, 75, and 50 cents to the above enlisted men, is authorized by order of the Navy Department, 28th June, 1880.		
CLOTHING.		
For 2,000 non-commissioned officers, musicians, and privates, at $40.27 per annum, actual cost....	80,540 00	
For 500 overcoats, at $10.02 each....	5,010 00	
		85,550 00
FUEL.		
For 3,894 cords of wood as follows: 1 colonel commandant, 1 colonel, 2 lieutenant-colonels, 4 majors, 3 staff majors, 2 staff captains, 12 captains, 15 first lieutenants, 15 second lieutenants, 1,000 non-commissioned officers, musicians, privates, and washerwomen, 6 hospitals, 1 armory, 5 mess-rooms for officers, 16 offices for commandant and staff and commanding officers of posts, 9 rooms for officers of the day, 9 guard-rooms at barracks and navy-yards, 3 stores for clothing and other supplies, one-fourth additional on 2,400 cords, the quantity supposed to be required in latitude north 36 degrees, from 1st September to 30th April, 600 cords, amounting in all to 3,894 cords; at $6 per cord....	....	23,364 00
MILITARY STORES.		
For pay of one chief armorer, at $3 per day, $939; 3 mechanics, at $2.50 per day, $2,347.50; in all....	3,286 50	
For purchase of military equipments, such as cartridge-boxes, bayonets, scabbards, haversacks, blanket-bags, canteens, musket-slings, swords, drums, bugles, flags, and spare parts for repairing muskets, &c....	9,000 00	
For purchase of 100 Springfield rifles, caliber 45, $15 each....	1,500 00	
For purchase of ammunition....	1,000 00	
For purchase and repair of instruments for band, and purchase of music....	500 00	
		15,286 50
TRANSPORTATION AND RECRUITING.		
For transportation of troops and the expenses of the recruiting service....	....	10,000 00
REPAIR OF BARRACKS.		
At Portsmouth, N. H.; Boston, Mass.; Brooklyn, N. Y.; League Island, Pa.; Annapolis, Md.; headquarters and navy-yard, Washington, D. C.; Gosport, Va.; and Mare Island, California....	15,000 00	
Rent of building used for manufacture of clothing, storing supplies, and offices of assistant quartermaster, Philadelphia, Pa....	2,000 00	
Hire of quarters for 6 enlisted men, employed as clerks and messengers in commandant's, adjutant and inspector's, paymaster's and quartermaster's offices, Washington, D. C., and assistant quartermaster's offices, Philadelphia, at $21 each per month....	1,512 00	
Hire of quarters for 3 enlisted men, employed as above, at $10 each per month....	360 00	
		18,872 00
NOTE.—Hire of quarters at $21 and $10 per month, for the above enlisted men, authorized by order of the Navy Department, dated 28th June, 1880.		

Estimates of appropriations required for the service of the fiscal year, &c.—Continued.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Total amount to be appropriated under each head of appropriation.
FORAGE.		
For forage in kind for 4 horses of the quartermaster's department and the authorized number of officers' horses	....	$5,400 00
CONTINGENCIES.		
For gas and oil at marine barracks, Portsmouth, N. H.; Boston, Mass.; Brooklyn, N. Y.; League Island, Pa.; assistant quartermaster's offices, Philadelphia, Pa.; Annapolis, Md.; headquarters and navy-yard, Washington, D. C.; Gosport, Va.; Pensacola, Fla.; and Mare Island, California	$4,742 85	
Water at marine barracks, Boston, Mass.; Brooklyn, N. Y.; Annapolis, Md.; and Mare Island, California	1,051 95	
Straw for bedding for enlisted men at the various posts	1,037 07	
Furniture for Government houses	5,000 00	
Freight, ferriage, toll, cartage, funeral expenses of marines, stationery, telegraphing, rent of telephones, apprehension of deserters, per diem to enlisted men employed on constant labor, repairs of gas and water fixtures, office and barrack furniture, mess utensils for enlisted men, such as bowls, plates, spoons, knives, forks, &c., packing-boxes, wrapping-paper, oilcloth, crash, rope, twine, carpenters' tools, tools for police purposes, purchase and repair of hose, repairs to public carryall, purchase and repair of harness, repair of fire-extinguishers, purchase and repair of hand-carts and wheelbarrows, purchase and repair of cooking stoves, ranges, &c., stoves where there are no grates, purchase of ice, towels, and soap for offices, improving parade grounds, repair of pumps and wharves, laying drain and water pipes, introducing gas, and for other purposes	18,423 89	
		30,255 76
HIRE OF QUARTERS.		
For hire of quarters for officers serving with the troops where there are no public quarters belonging to the Government, and where there are not sufficient quarters possessed by the United States to accommodate them	....	4,500 00
		264,848 56

QUARTERMASTER'S OFFICE, UNITED STATES MARINE CORPS,
Washington, September 10, 1884.

Respectfully submitted.

W. B. SLACK,
Quartermaster, Marine Corps.

HEADQUARTERS MARINE CORPS,
COMMANDANT'S OFFICE,
Washington, D. C., September 20, 1884.

SIR: Inclosed herewith is the annual estimate (in duplicate) for the support of the paymaster's department of the United States Marine Corps for the fiscal year ending June 30, 1886.

The item of "pay for thirty second lieutenants" is included, in compliance with your instructions to me.

Very respectfully, your obedient servant,

C. G. McCAWLEY,
Colonel Commandant.

Hon. WM. E. CHANDLER,
Secretary of the Navy,
Washington, D. C.

HEADQUARTERS MARINE CORPS,
Paymaster's Office, September 26, 1884.

SIR: I respectfully submit herewith estimates for the pay of officers, non-commissioned officers, musicians, privates, and others of the United States Marine Corps, for the fiscal year ending June 30, 1886. These estimates show an increase of $3,567 over the estimates presented for the present fiscal year, as follows:

Increase for payment to discharged soldiers for clothing undrawn, the payment under this head for the past two years having exceeded the sum of $30,000 per annum		$10,000
Decrease in pay of retired officers	$433	
Decrease in commutation of quarters for officers	6,000	
		6,433
Total increase		3,567

I am, very respectfully,

GREEN CLAY GOODLOE,
Major and Paymaster, Marine Corps.

The COLONEL COMMANDANT,
United States Marine Corps, Headquarters.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the paymaster United States Marine Corps.

Detailed objects of expenditure, and explanations.	Total amount to be appropriated under each head of appropriation.
Pay of officers on the active list:	
For the colonel commandant, one colonel, two lieutenant-colonels, one adjutant and inspector, one quartermaster, one paymaster, four majors, two assistant quartermasters, one judge-advocate-general United States Navy, nineteen captains, thirty first lieutenants, and thirty second lieutenants, per acts of June 30, 1830, 4 Stat., p. 713, secs. 4, 5; March 2, 1847, 9 Stat., p. 153, sec. 3; August 5, 1854, 10 Stat., p. 586, sec. 1; February 21, 1857, 11 Stat., p. 163, sec. 1; July 17, 1862, 12 Stat., p. 594, sec. 2; June 30, 1864, 13 Stat., p. 144, sec. 1; March 3, 1865, 13 Stat., p. 487, sec. 1; July 28, 1866, 14 Stat., p. 334, sec. 37; July 28, 1866, 14 Stat., p. 337, sec 13; March 2, 1867, 14 Stat., p. 422, sec. 37; July 5, 1870, 14 Stat., p. 517, sec. 1; January 18, 1875, 18 Stat., p. 301, sec. 7; Navy regulations, July 18, 1816; R. S., p. 271, secs. 1596, 1623	$196,440
Pay of officers on the retired list:	
For one colonel, three majors, two assistant quartermasters, four captains, and three second lieutenants, same acts	27,315
Pay of non-commissioned officers, musicians, and privates:	
For one sergeant-major, one quartermaster-sergeant, one drum-major, one leader of the band, fifty first sergeants, one hundred and forty sergeants, one hundred and eighty corporals, thirty musicians, ninety-six drummers and fifers, and one thousand five hundred privates, same acts	389,652
Pay of civil force:	
For ten clerks and two messengers, same acts	16,695
Undrawn clothing:	
For payment to discharged soldiers for clothing undrawn, same acts	30,000
Transportation:	
For transportation of officers traveling under orders, without troops, same acts	8,000
Cummutation of quarters:	
For commutation of quarters for officers on duty without troops	4,000
	670,843

HEADQUARTERS MARINE CORPS,
Paymaster's Office, September 26, 1884.

Respectfully submitted.

GREEN CLAY GOODLOE,
Major and Paymaster, Marine Corps.

No. 11.—MOVEMENTS OF VESSELS.

NORTH ATLANTIC STATION.

The force of this station remained under the command of Rear-Admiral George H. Cooper until July 26, 1884, when he transferred it to Acting Rear-Admiral S. B. Luce, and was retired from active service. On the 20th of September, Acting Rear-Admiral Luce was detached and Acting Rear-Admiral James E. Jouett succeeded in command of the squadron, which now comprises the Tennessee, flag-ship, Galena, Swatara, Alliance, and Yantic. The Vandalia was detached from duty on the station and was put out of commission at the navy-yard, Portsmouth, N. H., October 14.

The iron-clad monitors Passaic, Nantucket, and the torpedo-boat Alarm (a special squadron, under Commander E. C. Woodward), were attached to the station during the months of August and September, and cruised at sea.

TENNESSEE

Sailed from New York November 27, 1883, and anchored in Hampton Roads; from there went up to the navy-yard, and on the 11th of December dropped down to the Roads and proceeded the next day on a cruise to the West Indies, arriving at St. Thomas the 21st of December. Sailed thence December 29, 1883, and arrived at Port-au-Prince, Hayti, on January 2, 1884. The customary civilities were exchanged between the President of the Republic and the admiral. The vessel sailed on the 15th and reached Aspinwall on the 20th, where she remained until January 27th. During the stay at Aspinwall a careful examination was made of the work in progress upon the Panama Canal, and a full report was made to the Department, under the order of the admiral, by Lieut. R. P. Rodgers. From Aspinwall the Tennessee proceeded, January 27, to New Orleans, La., arriving there the 8th of February, and remaining until the 3d of March, when she sailed for Vera Cruz, Mexico, arriving March 8th. The admiral visited officially the city of Mexico and paid his respects to the President. On the 22d of March the Tennessee sailed for Havana, Cuba, arrived on the 27th, and remained until the 3d of April, when she sailed for Key West, reaching there the next morning. The admiral inquired into the alleged "Cuban expedition" from Key West, and remained until the 10th of May. On the last-named date the Tennessee departed for Hampton Roads, anchored off Fortress Monroe on the 14th of May, and proceeded May 26 to New York, arriving the 28th. On the 10th of July, in company with the Vandalia, Yantic, and Alliance, she sailed, cruised at sea, exercising in steam-fleet tactics, and various movements, and arrived at Portsmouth, N. H., on the 21st of July. While at Portsmouth the Tennessee, Vandalia, Swatara, Yantic, and Alliance, and the training-ships Portsmouth and Jamestown, participated in the reception of the

Greely Relief Expedition, August 1, and the officers and crew part in the municipal reception on shore August 4. The squad sailed for Narragansett Bay on the 6th of August, where they arrived the 16th, after having exercised at sea at naval tactics. On the morning of August 20, the squadron got under way for the purpose of testing the speed of vessels on the measured mile, and of ascertaining the tactical diameter of each vessel. The Swatara, Alliance, and Yantic were engaged in torpedo practice. On the 21st of September, the Tennessee, Swatara, Yantic, and Alliance sailed for New York, the Vandalia having left on the 4th for Portsmouth, N. H. The vessels arrived at New York on the following day.

VANDALIA

Sailed from Norfolk December 10, 1883, on a cruise to the West Indies and visited the following places: Port Castries, St. Lucia; Port of Spain, Trinidad; La Guayra, Venezuela; Curaçao; St. Marta, Savanilla, Cartagena, and Aspinwall, United States of Colombia; having arrived at the last-named port the 7th of March, 1884. On the 22d March sailed on a cruise to the Bahamas. On the 19th of May she finally left Matanzas, Cuba, for Key West, reaching there the next day and sailing on the 22d for New York, where she arrived on the 27th of May. She sailed September 4, and proceeded to the navy-yard, Portsmouth, N. H. From the 10th of July to the 5th of September the Vandalia was with the squadron in Narragansett Bay and vicinity exercising at naval tactics.

ALLIANCE

Arrived at Port au Prince December 6, 1883, from Boston, and visited during the first quarter of 1884 the ports of Santiago, Cuba; St. Nicolas Mole and Cape Haytien, Hayti; Puerto Plata, San Domingo; Salt Key and Grand Key, Turk's Islands; San Juan, Porto Rico; St. Thomas, Basse Terre, St. Kitt's; St. John's, Antigua; Pointe à Pitre, Guadaloupe; St. Pierre; Port Castries, St. Lucia; and Kingston, St. Vincent; reaching the last-named port the 27th of March. During the second quarter of the year the following ports were visited, the vessel having left Kingston the 1st of April: Key West, Fort Jefferson, Tortugas, Matanzas, Cardenas and Nuevitas, Cuba and Nassau, N. P. She left Nassau the 4th of June and arrived at Norfolk the 12th of that month; sailed the next day and arrived on the 16th at New York. From the 10th of July to the 21st of September the Alliance was with the squadron in Narragansett Bay and vicinity exercising at naval tactics. She returned to New York on the 22d of September.

SWATARA

Arrived at Port au Prince October 21, 1883, from Boston, and remained until January 28, 1884, when she visited the following-named ports: Miragoane, Kingston, the Boca del Toro, and Aspinwall, sailing from the last-named March 24, and arriving on the 31st at Key West. On the 4th of April left Key West, visited Cardenas and Matanzas, Cuba, and returned to Key West April 28. On the 10th of May sailed for New York, and, after a short stoppage at Hampton Roads, reached New York on the 28th of May. On the 16th of July the Alliance sailed for the Portsmouth, N. H., navy-yard, and remained there until the 6th of August. From that date until the 21st of September this vessel was

with the squadron in Narragansett Bay and vicinity exercising at naval tactics. She returned to the navy-yard, New York, on the 25th of September.

GALENA

Sailed from the navy-yard, New York, February 16, 1884, proceeded to Hampton Roads and thence on a cruise to the West Indies. She visited Kingston, Jamaica; Port au Prince and Cape Haytien, Hayti; San Juan, Porto Rico; St. Thomas; Frederickstedt, Santa Cruz, and arrived at Key West May 1, 1884. She remained at that port until the 16th of August, when sailed, arriving at Portsmouth, N. H., the 23rd of August.

YANTIC

Sailed from New York February 19, 1884, and visited the following ports: Nassau, N. P.; Port Nipe, Matanzas, and Havana, Cuba; Key West, Fla., and vicinity, arriving at the last-named port on the 22d of April. On the 22d of May, departed for New York, where she arrived on the 28th of May. From the 10th of July to the 21st of September the Yantic was with the squadron in Narragansett Bay and vicinity exercising at naval tactics. She returned to New York on the 22d of September.

SOUTH ATLANTIC STATION.

At present the Nipsic is the only vessel on this station; the flag-ship Brooklyn, flying the flag of Rear-Admiral T. S. Phelps, having returned to New York early in October, 1884.

BROOKLYN,

On her return from the East and West coasts of Africa to the east coast of South America, visited the island of St. Helena, arriving on the 24th of April, 1884, and departing on the 6th of May. She returned to Montevideo, Uruguay, on the 5th of June. Sailed on the 14th of July, arrived at Rio de Janeiro, Brazil, the 21st, and on the 1st of September departed for New York, where she arrived the 8th of October.

NIPSIC

Sailed from Montevideo January 5, 1884, and visited Buenos Ayres and Rio de Janeiro.

PACIFIC STATION.

The force on this station is now commanded by Rear-Admiral John H. Upshur, who succeeded Rear-Admiral A. K. Hughes on the 8th of April, 1884, upon that officer's retirement from active service.

The following vessels comprise the squadron: the flag-ship Hartford, Shenandoah, Lackawanna, Wachusett, Iroquois, and Pinta. The last-named vessel, in September last, relieved the Adams prior to her being put out of commission.

HARTFORD

Sailed from Valparaiso, Chili, January 9, 1884, arrived at Honolulu, Hawaiian Islands, February 24. On the 27th the admiral called on

the King, and on the 28th His Majesty visited the ship and was received with appropriate honors. The vessel left Honolulu March 4, and arrived at San Francisco March 17, and at the navy-yard, Mare Island, Cal., on the 31st of March. She left the navy-yard on the 24th of April and proceeded as far as San Pedro, Cal., having touched at Monterey and Santa Barbara, Cal., when she returned to the yard for rep arriving on the 24th of May. On the 2d of July she again sailed fi the yard, touched at Pichilinque, Lower California; Mazatlan ana Acapulco, Mexico; San José de Guatemala; Corinto, Nicaragua; Panama, United States of Colombia; Payta, Peru, and reached Callao the 27th of September.

SHENANDOAH

Left Montevideo, on the South Atlantic station, March 30, 1884, touched at Sandy Point, Patagonia, and arrived at Valparaiso May 5. Sailed the 15th of May, and visited Coquimbo, Chili; Callao, Peru, Payta, Peru, arriving at the last-named port September 11th. On the 21st of October last the vessel was at Callao.

LACKAWANNA,

During the last quarter of 1883, and the first, second, and third quarters of this year, has been cruising between Valparaiso and Callao. On the 21st of October (last advice) she was *en route* to Callao fr Panama, and was expected to arrive on the 23d of October.

WACHUSETT

Arrived at Callao December 2, 1883, and on the 25th of February, 1884, sailed and visited Arica and Iquique, Peru; Valparaiso, and Coquimbo, returning to Callao the 28th of June. On the 4th of August left Callao and visited Payta; Chatham Island; Bahia, Manta, Ballerita Puna, and Guayaquil, Ecuador; and Timbez and Payta, Peru, returning to the last-named port September 12. At last advices, October 21, the vessel was at Callao.

IROQUOIS

Arrived at Talcahuano January 9, 1884; visited Valparaiso; Cal a; Antofagasta, Bolivia; Iquique, Arica, Pisco, Peru; and reached (ao on the 17th of April. At last advices (October 21) the ve l cruising in Australian waters, and was expected to return to the s about February 15, 1885.

PINTA

Arrived at Sitka, Alaska, August 17, 1884, and relieved the Adams.

ADAMS

Left Sitka, where she had been long stationed, on the 19th, and arrived at the Mare Island navy-yard the 28th of August.

MONONGAHELA.

The store-ship Monongahela was put in commission July 10, 1884, at the Mare Island navy-yard, and arrived at Callao September 10, after a passage of 53 days from San Francisco.

PENSACOLA,

Former flag-ship, sailed on a cruise around the world from Callao, Peru, to Hampton Roads, Va. She left Callao on the 12th of July, 1883, and arrived at Hampton Roads the 4th of May, 1884, having visited the following ports: Honolulu, Hawaiian Islands; Yokohama, Kobe, Nagasaki, Japan; Hong-Kong, China; Singapore, India; Batavia, Java; Tamatave and Tenerine, Madagascar; Port Elizabeth and Cape Town, South Africa; St. Helena, Barbadoes, and the Bermudas.

EUROPEAN STATION.

T is station is now under the command of Rear-Admiral Earl English, relieved Rear-Admiral C. H. Baldwin on the 20th of September, 1884, after the retirement from active service of the last-named officer. present the force on the station consists of the Lancaster (flag-ship), ge, and Quinnebaug. In July last the squadron, while ren- vo ng at Lisbon, received new officers and crews for the flag-ship, t Quinnebaug, from the United States steamship Powhatan, t nsferred those whose term of service had expired to that vessel p ge to New York.

LANCASTER

led October 5, 1883, from Cadiz, Spain, and visited the ports of ache, France; Leghorn and Messina, Italy; Palermo, Sicily; uria, Egypt; Jaffa and Beirut, Syria; Larnaca, Cyprus; and Chanak, Turkey; Tenedos; the Piræus, Greece; Messina, ly; rseilles, France; Malaga, Spain, and Gibraltar, arriving at -named place June 27, 1884. Sailed July 1, and visited Lisbon, ; Corunna, Spain; and Southampton, England, arriving the of August. Intended to leave the 7th of October for Lisbon direct.

KEARSARGE

Visited Mogador and Casa Blanca, Morocco, and arrived at Gibraltar, October 8, 1883. Sailed on the 9th of that month and visited Malaga, Cartagena and Alicante, Valencia, and Barcelona, Spain; Algiers, Algeria; Port Mahon, Minorca; Marseilles and Villefranche, France; reaching the last-named port December 1, 1883. On the 8th of January, 1884, departed, and visited Genoa, Spezzia, Leghorn, Civita Vecchia, Naples, and Palermo, Italy. Sailed from the last named place the 28th of February, and reached Alexandria on the 4th of March. t on the 28th for Port Said, and thence, after coaling, proceeded to , arriving on the 31st of March. Sailed on the 9th of April and ed Beirut, Larnaka, Smyrna, Salonica, the Piræus, Lata Kiyah, Tripoli, Sidon, Acre, Haifa, and returned to Alexandria on the 27th of June. Sailed July 1, visited Zante and Corfu, Greece; Trieste, Austria; aga and Cadiz, Spain; and Lisbon, Portugal; reaching the last- d port the 16th of September. At last advices, October 6, she still at Lisbon, under orders to cruise on the coast of Africa.

QUINNEBAUG

Remained at Leghorn, undergoing repairs, from September, 24, 1883, until March 31, 1884, when she sailed and visited Goletta, Tunis; Tripoli;

Alexandria, Egypt; Smyrna, Tenedos, Chanak, and Constantinople, Turkey; the Piræus, Greece; Messina, Sicily; Cagliari, Sardinia; celona and Malaga, Spain; arriving at Gibraltar the 27th of J Sailed July 5, reached Lisbon the 7th, left on the 23d and arrived Southampton, England, the 29th of July. On the 30th of August and visited St. Helen's Roads, Isle of Wight; Deal, North Shields Flamborough Head, England; Leith, Scotland; Antwerp, Belgi Cuxhaven and Gluckstadt, Germany; arriving at the last-named the 30th of September. She is under orders to proceed to Hamb Germany, and thence to Lisbon, so timing her movements as to r Lisbon not later than the 15th of October.

ASIATIC STATION.

This station is commanded by Acting Rear-Admiral John Lee Davis, who assumed the command December 19, 1883, and whose flag is b by the Trenton. During the past year the Richmond and Essex have been ordered home, and the squadron increased by the arrival of Trenton, Ossipee, and Alert. The Enterprise, Juniata, Monocacy, Palos remain attached to the station.

TRENTON

Left New York in the month of November, 1883; visited Marseill France; Naples, Italy; Port Said; Suez; Aden; Bombay; Col Ceylon; and Singapore, and arrived at Hong-Kong May 1, 1884; le 10th, reached Nagasaki the 17th; sailed the 28th, arrived at Ch Korea, the 31st, where remained until June 27, when left and arrive Nagasaki, Japan, the 29th of June; sailed on the 12th of July, v Kobe and Yokohama, Japan; Woosung and Shanghai, China. At accounts, Octob r 2, she was still at Shanghai.

OSSIPEE

Left Hampton Roads, Virginia, the 30th of April, touched at the A and arrived at Gibraltar on the 27th of May. Sailed 13th June, Palermo; Messina; Port Said, Ismalia, and Suez, Egypt; Aden; lombo; Singapore; and Hong-Kong, arriving at the last-named September 1. Left for Shanghai the 15th, and arrived there the 2 September. At last accounts, October 2, she was still in port.

JUNIATA

Left Canton, China, January 17, 1884; visited Hong-Kong, Swa and Amoy, China, and arrived at Shanghai the 2d of January. Sa on the 15th, reached Nagasaki the 18th; departed on the 24th, arrived at Roze Island, Korea, the 29th of January. Sailed the 20th May, arrived at Nagasaki the 26th, and Shanghai the 7th of June. Le on the 19th, and returned to Nagasaki the 21st of June. Sailed the 12th of July; visited Kobe and Yokohama, Japan; Shanghai an Ningpo, China, and returned to Shanghai on the 25th of Septem and at last accounts, October 2, was still at that port.

ENTERPRISE

Arrived at Nagasaki February 13, 1884, from Roze Island, Korea, proceeded to Chefoo and Shanghai, reaching the last-named place

h of March. On the 13th of April sailed and visited Hong-Kong, on, Macao, Swatow, Amoy, Foochow, Ningpo, Shanghai, Hankow, Kiang, and Chin-Kiang, China, returning to Nagasaki on the 21st June. Sailed July 12, reached Kobe the 17th, departed on the 19th, ived at Yokohama the 21st, and on the 27th left for Shanghai. ed Woosung, Foochow, Shanghai, Tung-chow-foo, Chefoo, arriving last-named port on the 28th of September.

ESSEX

Left Nagasaki on the 27th of November, 1883; visited Amoy, Swatow [ong-Kong, Canton, and returned to Nagasaki on the 17th of March, 8 . Sailed on the 20th; visited Jabout, Marshall Island, Yokohama, Kobe, and returned to Nagasaki the 4th of June. Sailed thence the 12th of July for the United States.

MONOCACY

Arrived at Shanghai November 24, 1883, where she remained until 'ebruary 16, 1884, when sailed and visited Ningpo, Foochow, Amoy, Swatow, Hong-Kong, Canton, and Shanghai, arriving at Shanghai on he 13th of June. Sailed on the 30th of July and reached Foochow 2d of August, where she was at last advices.

ALERT

Arrived at Nagasaki the 18th of February, 1884, having left the navy-l at Mare Island, California, November 24, 1883, and stopped at lulu. Sailed on the 26th; visited Shanghai and returned to Naga-the 13th of June. Sailed on the 23d and reached Chemulpo, Korea, 25th of June. On the 9th of August, departed and returned to aki the 12th of that month. Left Nagasaki on the 16th, reached Hong-Kong the 26th; and on the 28th arrived at Canton, where she at last advices.

PALOS

Arrived at Tien-Tsin November 18, 1883; sailed on the 8th of March, 884; visited Taku, Woosung, and Shanghai, arriving at the last named rt the 19th of March. On the 13th of May departed and visited ;po, Kintung, Foochow, Hoo-i-tan Bay, Amoy, Hong-Kong, and Canton, arriving at the last-named port the 29th of May. Sailed on the th of July, visited Hong-Kong and returned to Canton the 20th of July. On the 28th of August departed and visited Swatow, Shanghai, and Chin-Kiang, arriving at the last-named port on the 23d of September.

RICHMOND,

Former flag-ship on the station, left Hong-Kong April 9, 1884, on her eturn to the United States via the Suez Canal. She arrived at New York on the 22d of August.

SPECIAL SERVICE.

POWHATAN

In July last was sent to Port Royal, S. C., and received on board the Government coal at that station preparatory to its being broken up. Employed until June 26 on Atlantic coast. June 26, sailed from New York for Lisbon, Portugal, with relief officers and crews for the Lan-

caster and Quinnebaug. Returned to New York with the old officers and crews of these vessels August 21. Has since been employed in carrying Government freight to different yards.

TALLAPOOSA

Employed in carrying freight, &c., to the navy-yards on the A coast until August 24, 1884, when she was sunk, the schooner J. S. Lowell having collided with her about 5 miles east of Vineyard Haven.

RANGER.

Surveying on Mexican and Central American coasts.

MICHIGAN.

Service on the lakes.

DESPATCH.

Washington navy-yard, waiting orders.

NINA

Was placed in command of Lieut. Commander R. B. Hitchcock, New York, August 27, and was employed at the scene of the wre of the Tallapoosa. She returned to New York in October.

PASSAIC

Was put in commission at Annapolis late in April, and was put of commission there October 18. She formed a part of a special squadron under Commander Woodward.

NANTUCKET

Was commissioned at Norfolk June 16, 1884, and put out of commission at New York October 6. She formed a part of a special squadron under Commander Woodward.

ALARM

Formed a part of the special squadron under Commander Woodward from early in July until October 6, when put out of commission at York.

APPRENTICE TRAINING SQUADRON.

The apprentice training squadron remained under the command Commodore S. B. Luce until the 30th of June, 1884. The vessels the New Hampshire (flag-ship) and the sailing ships Portsmouth, town, and Saratoga.

PORTSMOUTH

Sailed from Norfolk, Va., the 26th of February, 1884, on a cruise to Martinique and St. Thomas, and arrived April 28, 1884, at Newport, R. I., with yellow fever. Proceeded to Norfolk in October, and arrived there November 3.

JAMESTOWN

Sailed the 18th of February, 1884, from Newport on a cruise to the Windward Islands, West Indies, touching at Pointe à Pitre, Guadaloupe, Basse-Terre, St. Christopher, and St. Thomas. She returned to Newport on the 9th of June, 1884. Proceeded to Norfolk in October, arriving there the 31st.

SARATOGA

Sailed March 3, 1884, from New York on a cruise to Lisbon, Portugal; Porto Praya, Cape de Verde Islands; Funchal, Madeira, and Santa Cruz, West Indies. She arrived at Newport on the 2d of July, 1884. Proceeded to Norfolk in October, and arrived there November 3.

No. 12.—SALE OF OLD VESSELS.

MEMORANDUM CONCERNING THE SALE, UNDER THE FIFTH SECTION OF THE DEFICIENCY ACT APPROVED MARCH 3, 1883, OF VESSELS STRICKEN FROM THE NAVY REGISTER.

NAVY DEPARTMENT,
Washington, November 24, 1884.

In a memorandum of November 30, 1883, which accompanied the report of the Secretary of the Navy, December 1, 1883, pages 162–163, I stated that the total amount of sales of old vessels to that date was $384,753.

In this sum was included the price which was offered for the Niagara, $29,000. The sale of that vessel having been subsequently set aside for informality, this $29,000 should be deducted from the aggregate amount reported ($384,753), leaving $355,753 as the amount actually realized from the sales made in June and November, 1883.

May 3, 1884, the Pawnee, Supply, and Benicia were sold for the sum of $24,312, increasing the total receipts to $380,065, which is the entire sum for which the Secretary of the Navy is accountable.

The following is an exhibit of the dates of the deposit in the Treasury of the sums received:

Date.	No. of certificate of deposit.	Amount of deposit.
1883.		
Sept. 27	27804	$1,400 00
Oct. 1	27832	12,140 00
1	27836	35,627 70
4	27849	26,585 00
6	27863	19,935 00
12	27911	7,296 00
18	27950	13,183 20
25	28005	9,990 00
31	28054	145,306 15
Nov. 22	28215	30,198 00
1884.		
May 9	29263	21,231 20
13	29298	*46,287 00
27	29389	5,400 00
6	29461	1,170 00
Total	....	386,815 05

* This sum was originally deposited in the office of the Assistant Treasurer at San Francisco, December 3, 1883.

These deposits included the following sums:

Over deposit on the Seaweed	$350 00
Ten per cent. deposit on the bid for the Niagara	2,900 00
Ten per cent. deposit on the bid for the Colorado	3,500 00
	6,750 00

And an overpayment on account of the Roanoke of 5 cents in excess of the purchase money.

The $6,750 having been refunded to the bidders, there was left in the Treasury to the credit of the Secretary of the Navy $380,065.05. Of this sum $200,000 were covered into the Treasury the 18th day of April, 1884, by the Secretary of the Navy, and 20 cents, subsequently, by Paymaster Peterson; leaving the Secretary of the Navy otherwise to account for the sum of $180,064.85.

The account current herewith transmitted (a duplicate of that sent to the Fourth Auditor of the Treasury by the Secretary of the Navy, with the necessary vouchers for its proper settlement) made up to September 30, 1884, shows the sums received at different times from the sale of old vessels and the disbursements on account thereof. It will be seen by the account current that the following sums were paid out by the Secretary of the Navy to September 30, 1884:

For advertising		$9,202 80
For printing		9 96
For Colorado, stripping for sale	$503 34	
For Ticonderoga, stripping for sale	586 21	
		1,089 55
For tools		49 50
For labor in breaking up old vessels, viz:		
Connecticut	$18,743 41	
Canandaigua	9,196 00	
Colossus	5,491 57	
Java	1,280 29	
Massachusetts	11,915 65	
Plymouth	2,747 63	
Virginia	225 68	
Pennsylvania	12,256 30	
Oregon	2,107 30	
Snowdrop	231 89	
		64,195 72
Total		74,547 53
Leaving to be accounted for		105,517 32
There was on deposit in the Treasury of the United States by the special account of the Secretary of the Navy on the 30th of September last, as per statement of the Treasurer		98,823 74
Against which there was an outstanding check of		50 00
Leaving a net balance subject to check of		98,773 74
And paymasters had in their hands (remittances unexpended) for disbursement in breaking up old vessels		6,743 58
		105,517 32
Of the sum in the Treasury on the 30th September subject to check		98,773 74
There has been drawn out up to November 24—		
Overpayment, purchase of the Roanoke	$0 05	
Remittances to paymasters to be used in breaking up vessels	67,018 00	
To pay for advertising	100 50	
		67,118 55
Leaving in the Treasury to the special account of the Secretrary of the Navy		31,655 19

The following vessels are in process of being broken up, in accordance with instructions of the Department of August 14, 1884: Colossus and Java, at New York; Massachusetts and Plymouth, at Portsmouth, N. H.; Oregon and Pennsylvania, at Boston.

The instructions referred to were as follows:

NAVY DEPARTMENT,
Washington, August 14, 1884.

SIR: Having fully considered the subject, the Department has decided to carry out the recommendation of the Naval Board of Inspection and the Chief of the Bureau of Construction and Repair as to the disposition of the unfinished vessels at the several navy-yards; that is, that they be broken up by the Bureau of Construction and Repair by day's labor.

The necessary orders will, therefore, be given by you to break up in that manner the Massachusetts and the Plymouth.

You are enjoined to see that the work is done with the strictest economy, so as to keep the expenditures down to the value of the old material to be realized from the ships when broken up; and as the same skilled labor required to build a ship is not necessary to break her up, only a small number of shipwrights, receiving full pay as such, are to be employed, together with a limited number of borers, who will be paid in like manner, on these vessels. All other workmen so employed are to be paid as laborers.

The object of the Department in having these vessels broken up by the Bureau of Construction in the yard is not to give employment to workmen, but to clear the yard of the useless ships at the lowest possible cost.

You will furnish the naval constructor of the yard with a copy of these instructions, and inform him that the Department expects to receive his hearty co-operation in carrying them out.

Very respectfully,

EARL ENGLISH,
Acting Secretary of the Navy.

Rear-Admiral C. H. WELLS,
Commandant Navy-Yard, Portsmouth, N. H.

Similar instructions were given to the commandant at Boston about the Oregon and Pennsylvania, and to the commandant at New York about the Colossus and the Java.

Until this work is completed, under the provisions of section 6 of the act of March 3, 1883, which require that the cost of removing vessels shall be paid from the proceeds of sales, the amount remaining in the Treasury to the credit of the Secretary of the Navy on his special account cannot be covered into the Treasury, but must be retained to complete the work of breaking up, unless a suspension of such work should be ordered.

The Board of Inspection submitted the following estimate of the cost of breaking up the six vessels named and of the value of materials that would be obtained therefrom:

Names of vessels.	Value of old metal in vessels and machinery.	Cost to break up and recover metals.
Massachusetts	$13,494 86	$20,000 00
Oregon	11,307 54	20,000 00
Pennsylvania	12,742 00	16,000 00
Java	12,453 48	16,000 00
Colossus	12,957 27	20,000 00
Plymouth	10,522 50	15,000 00
	73,477 65	107,000 00

The serviceable materials recovered from the vessels broken up will be stored and preserved for future use. The materials not fit for further use will be sold, and the proceeds covered into the Treasury as miscellaneous receipts.

The old wood remaining from breaking up the Connecticut was sold at auction as firewood on the 4th of March, 1884, at the Boston navy-yard, and realized the sum of $852.74, out of which advertising bills

and auctioneer's fees, amounting to $26.82, were paid, leaving a net amount of $825.92, which was covered into the Treasury by Paymaster Tarbell, who received it on the 14th October, 1884, under the head of "Miscellaneous receipts, proceeds of sale of Government property."

Value of the materials turned in from the breaking of the—	
Connecticut	$20,558 17
Canandaigua	6,696 22
	27,254 39

which, added to the estimated value of the materials to be turned in from the six other vessels named, makes a total of $100,732.04.

Total estimated cost of breaking up six vessels now in course of removal.		$107,000 00
Of this sum there was expended to September 30, 1884, per account current	$35,848 24	
And from October 1 to November 15, 1884	54,073 30	
Making the total amount expended to date		89,921 54
Balance, per estimate required to finish breaking up		17,078 46

The balance in the hands of the three paymasters at Portsmouth, Boston, and New York, respectively, where the six vessels above named are being broken up, after paying the rolls to the 15th instant, were as follows:

Portsmouth	$5,795 97
Boston	8,259 43
New York	5,420 79
	19,476 19
Estimated balance required to finish vessels	17,078 46
Surplus now in the hands of the above paymasters	2,397 73
Unexpended balances in the hands of other paymasters	212 09
On deposit in the United States Treasury November 15, 1884	31,655 19
Total probable amount to be covered into the Treasury	34,265 01

This is, of course, an estimate only, and liable to change according to the actual cost of completing the work. There are also one or two outstanding bills for advertising yet unsettled.

The U. S. S. Onward was advertised for sale at Callao on the 14th instant, and, if sold, the net proceeds were to be covered into the Treasury at once. No information of the amount realized has been received.

JNO. W. HOGG,
Chief Clerk.

William E. Chandler, Secretary of the Navy, in account-current with the United States, for proceeds of sales of old vessels.

Date.		Amount.	Total.
	RECEIPTS.		
1883.	To proceeds of the following old vessels of the Navy, condemned and stricken from the register under the provisions of the second section of the act approved August 5, 1882, making appropriations for the naval service, and sold this date after appraisal and due advertisement, in accordance with the fifth section of the act to supply deficiencies, &c., approved March 3, 1883; 10 per cent. of bid required to accompany it, and balance in full of accepted bids required to be paid within 30 days, viz:		
Sept. 24	Blue Light to M. H. Gregory, Great Neck, N. Y	$1,011 00	
24	Burlington to Delamater & Co., New York City	3,135 00	
24	Congress to H. E. Lynch, New York City	26,006 00	
24	Dictator to A. Purvis & Son, Philadelphia	40,250 00	
24	Frolic to J. P. Agnew, Alexandria, Va	11,250 00	
24	Glance to W. H. Swift, Boston	1,505 00	
24	Guard to C. A. Williams & Co., New London, Conn.	5,050 00	
24	Iowa to Hubbell & Porter, Syracuse, N. Y	44,605 00	
24	Kansas to Israel L. Snow, Rockland, Me	7,100 00	
24	New Orleans to A. Wilkinson, jr., Syracuse, N. Y	427 50	
54	Ohio to Israel L. Snow, Rockland, Me	17,100 00	
24	Relief to J. P. Agnew, Alexandria, Va	3,850 00	
24	Roanoke to E. Stannard, Westbrook, Conn	45,070 50	
24	Sabine to Israel L. Snow, Rockland, Me	11,100 00	
24	Savannah to E. Stannard, Westbrook, Conn	12,408 00	
24	Seaweed to M. J. Dady, Brooklyn, N. Y	650 00	
24	Shawmut to E. Stannard, Westbrook, Conn	8,106 00	
24	Susquehanna to E. Stannard, Westbrook, Conn.	13,143 00	
24	Sorrel to A. Purvis & Son, Philadelphia	400 00	
24	Worcester to E. Stannard, Westbrook, Conn	27,611 00	
	Total amount of sale of September 24, 1883		$279,273 00
24	To amount 10 per cent. upon the proposal of H. E. Lynch, of New York City, to purchase the U. S. S. Niagara for $29,000, accepted by the Navy Department but afterwards set aside by it for informality and money returned		2,900 00
24	To difference in amount of purchase money of the U. S. S Seaweed, and amount forwarded with the proposal of M. J. Dady for the purchase of that vessel; difference returned to him		350 00
24	To amount overpaid on the purchase of the U. S. S. Roanoke by E. Stannard and due him		65
	To proceeds of the following old naval vessels at the navy-yard, Mare Island, Cal., condemned and stricken from the register and sold to the highest bidder under the provisions of law previously named, viz.:		
	Sold to W. E. Mighell, San Francisco, Cal.—		
Nov. 20	Alaska	25,050 00	
20	Monadnock	15,150 00	
20	Narragansett	11,050 00	
20	Nyack	6,050 00	
20	Saco	6,850 00	
20	Tuscarora	12,330 00	
	Total amount of sale of November 20, 1883		76,480 00
1884.	To proceeds of the following old naval vessels condemned and stricken from the register and sold to the highest bidders this date on the terms and under the provisions of law previously named, viz.:		
May 3	Pawnee, sold to M. H. Gregory, Great Neck, N. Y	6,011 00	
3	Supply, sold to M. H. Gregory, Great Neck, N. Y	1,301 00	
3	Benicia, sold to W. E. Mighell, San Francisco, Cal	17,000 00	
	Total amount of sale of May 3, 1884		24,312 00
3	To 10 per cent. upon the proposal of Messrs. Delamater & Co. of New York City, to purchase the U. S. S. Colorado for $35,000, accepted by the Navy Department but afterwards set aside by it for informality and deposit returned		3,500 00
	Total		386,815 65
	EXPENDITURES.		
1883. Oct. 11	By balance of deposit made by M. J. Dady, of Brooklyn, N. Y., with his bid for the purchase of the U. S. S. Seaweed refunded to him, being this amount more than the purchase money of said vessel. Paid by check on the United States Treasury at Washington, No. 150,215		350 00

William E. Chandler, Secretary of the Navy, in account-current with the United States—Continued.

Date.		Amount.	Total.
	EXPENDITURES—Continued.		
1883.			
Apr. 5	By amount of 10 per cent. deposit made by Henry E. Lynch, of New York City, with his proposal to purchase the U. S. S. Niagara for $29,000, returned to him upon the Navy Department's setting aside his bid for informality. Paid by check on the United States Treasury, Washington, No. 150,261		$2,900 00
May 12	By amount of 10 per cent. deposit made by C. A. Delamater & Co., with their proposal to the U. S. S. Colorado for $35,000, returned to them upon the Navy Department's setting aside their bid for informality. Paid by check on the United States Treasury, No. 150,280		3,500 00
	Cost of advertising for proposals to purchase.		
1883.	Advertising the following-named vessels, under orders dated June 21, 1883, viz.: Blue Light, Burlington, Congress, Dictator, Frolic, Florida, Glance, Guard, Iowa, Kansas, New Orleans, Niagara, Ohio, Pawnee, Relief, Roanoke, Sabine, Savannah, Seaweed, Shawmut, Sorrel, Supply, Susquehanna, and Worcester, as follows:		
Oct. 10	Sunday Herald, Washington, voucher 1	$118 25	
10	Washington Chronicle, Washington, voucher 2	118 68	
10	Sun and Item, Philadelphia, voucher 3	213 00	
10	North American, Philadelphia, voucher 4	140 70	
10	Philadelphia Inquirer, Philadelphia, voucher 5	151 20	
10	Messager Franco-Américain, New York City, voucher 6	229 60	
10	Der New York Republikaner, New York City, voucher 7	231 00	
10	Nautical Gazette, New York City, voucher 8	204 75	
10	Army and Navy Journal, New York City, voucher 9	150 77	
10	New York Times, New York City, voucher 10	227 50	
10	Daily Chronicle, Portmouth, N. H., voucher 11	48 75	
10	Norfolk Landmark, Norfolk, Va., voucher 12	43 50	
11	Philadelphia Record, Philadelphia, voucher 13	190 40	
12	Evening News, Philadelphia, voucher 14	161 70	
12	The Press Company, Philadelphia, voucher 15	179 20	
12	New York Maritime Register, New York, voucher 16	546 00	
13	Brooklyn Eagle, Brooklyn, N. Y., voucher 17	132 30	
13	Boston Journal, Boston, voucher 18	73 50	
16	Evening Bulletin, Philadelphia, voucher 19	147 00	
16	New York Tribune, New York, voucher 20	243 60	
20	Army and Navy Register, Washington, voucher 21	130 16	
Nov. 1	Washington Post, Washington, voucher 22	155 40	
5	Sanitary Engineer, New York, voucher 23	124 80	
17	Daily Evening Traveller, Boston, voucher 24	141 75	
21	Norfolk Review, Norfolk, Va., voucher 25	12 00	
30	The Wedge, Norfolk, Va., voucher 26	28 00	
Dec. 3	Public Ledger, Philadelphia, voucher 27	196 00	
5	Advance-Gazette, Pensacola, voucher 28	60 00	
6	New York Commercial Advertiser, New York, voucher 29	170 80	
18	National Republican, Washington, voucher 30	117 25	
1884.			
Jan. 11	New York Herald, New York, voucher 31	319 20	
14	Portsmouth Journal, Portsmouth, N. H., voucher 32	21 00	
May 1	Evening Star Newspaper Company, Washington, voucher 33	108 25	
June 9	Boston Herald, Boston, voucher 34	108 50	
1883.	For same vessels, order dated July 27, 1883:		
Nov. 20	Daily Times, Portsmouth, Va., voucher 35	27 20	
	Total amount of advertising bills paid to September 30, 1884, for sale of September 24, 1883	5,271 71	
	By advertising the following named vessels under orders dated August 14, 1883, viz. Alaska, Benicia, Monadnock (old), Narragansett, Nyack, Saco, and Tuscarora, as follows:		
3	Morning Herald, New York, voucher 36	54 60	
19	Boston Journal, Boston, voucher 37	56 87	
20	Philadelphia Inquirer, Philadelphia, voucher 38	109 80	
Dec. 1	The Press, Philadelphia, voucher 39	136 80	
1	Baltimore American, Baltimore, voucher 40	76 50	
1	New York Tribune, New York, voucher 41	176 40	
3	Daily Evening Traveller, Boston, voucher 42	102 00	
4	The Sun, Philadelphia, voucher 43	148 80	
6	Commercial Advertiser, New York, voucher 44	127 20	
28	Daily Morning Chronicle, Portsmouth, N. H., voucher 45	35 75	
1884.			
Jan. 7	Journal of Commerce, San Francisco, voucher 46	33 75	
17	Vallejo Daily Chronicle, Vallejo, Cal., voucher 47	32 50	
19	Alta California, San Francisco, voucher 48	72 00	

William E. Chandler, Secretary of the Navy, in account-current with the United States—Continued.

Date.		Amount.	Total.
	EXPENDITURES—Continued.		
1883.			
	For same vessels, under order of September 18, 1883:		
Dec. 1	New York Maritime Register, New York, voucher 49	$288 00	
	Total amount of advertising bills paid to September 30, 1884, for sale of November 20, 1883	1,450 97	
	Add total for sale of September 24, 1883	5,271 71	
	Total amount of advertising bills	6,722 68	
1884.			
	By advertising the following-named vessels under orders dated March 3, 1884, viz, Benicia (second time advertised), Colorado, Cyane, Florida (second time advertised), Pawnee (second time advertised), Supply (second time advertised), and Ticonderoga, as follows:		
Apr. 15	Messager Franco-Amércain, New York, voucher 50	160 00	
28	Morning Herald, Baltimore, voucher 51	66 00	
	North American, Philadelphia, voucher 52	70 80	
30	Baltimore American, Baltimore, voucher 53	54 00	
May 1	Evening Bulletin, Philadelphia, voucher 54	72 00	
3	Sunday Herald, Washington, voucher 55	87 50	
5	Norfolk Landmark, Norfolk, voucher 56	23 80	
5	Daily Evening Traveller, Boston, voucher 57	74 67	
5	Portsmouth Journal, Portsmouth, N. H., voucher 58	15 50	
6	Washington Chronicle, Washington, voucher 59	73 75	
6	Army and Navy Register, Washington, voucher 60	65 60	
6	Nautical Gazette, New York, voucher 61	116 00	
9	The Press, Philadelphia, voucher 62	91 20	
10	Camden Daily Post, Camden, voucher 63	54 40	
12	Sanitary Engineer, New York, voucher 64	68 40	
15	Vallejo Chronicle, Vallejo, voucher 65	27 00	
20	New York Herald, New York, voucher 66	190 80	
21	Washington Post, Washington, voucher 67	69 60	
26	Philadelphia Inquirer, Philadelphia, voucher 68	78 00	
31	Journal of Commerce, San Francisco, voucher 69	22 00	
31	Evening Star, Washington, voucher 70	67 20	
June 2	Public Ledger, Philadelphia, voucher 71	78 40	
2	Philadelphia Record, Philadelphia, voucher 72	94 40	
2	New York Republikaner, New York, voucher 73	144 00	
2	Virginia Seaport, Norfolk, Va., voucher 74	14 00	
3	Daily Chronicle, Portsmouth, N. H., voucher 75	24 75	
3	New Yorker Zeitung, New York, voucher 76	78 00	
4	Army and Navy Journal, New York, voucher 77	99 20	
16	Portsmouth Daily Times, Portsmouth, Va., voucher 78	23 80	
July 23	Daily Evening Post, San Francisco, Cal., voucher 79	72 00	
Sept. 16	Boston Journal, Boston, voucher 80	42 75	
Sept. 16	New York Tribune, New York, voucher 81	120 00	
Sept. 16	Commercial Advertiser, New York, voucher 82	84 80	
	For advertising same vessels March 15, 1884:		
May 25	Norfolk Virginian, Norfolk, Va., voucher 83	23 80	
June 18	Richmond Whig, Richmond, Va., voucher 84	32 00	
	Total amount of advertising bills paid to September 30, 1884, for sale of May 3, 1884	2,480 12	
	Amount of advertising bills of previous sales	6,722 68	
	Total amount paid for advertising to September 30, 1884		$9
Mar. —	By amount paid to S. P. Rounds, Public Printer, for printing blank proposals to purchase, voucher 85		[illegible]
Apr. 18	By amount deposited in the Treasury of the United States at Washington, D. C., as "Miscellaneous receipts, proceeds of Government property, on account of proceeds of sales of old vessels," per certificate of deposit No. 30665		200,000
July 3	By amount deposited in subtreasury of the United States, New Orleans, La., erroneously made by Passed-Assistant Paymaster A. Peterson, navy-yard, Pensacola, in his own name and included in his account, deposited as "Miscellaneous receipts, proceeds of sales of old vessels," per certificate of deposit, New Orleans, No. 140		
May 31	By amount paid for stripping old vessels ready for sale:		
	United States ship Ticonderoga, navy-yard, Brooklyn, N. Y., for labor employed, per pay-roll and statement herewith, voucher 86 (in part)	503 34	
	United States ship Colorado, navy-yard, Brooklyn, N. Y., for labor employed, voucher 86, remainder	586 21	
	This total amount for stripping vessels was erroneously included in the general pay-roll of the construction department of the Brooklyn yard for May, and also erroneously included by Pay-Director Eldredge in his accounts		1,

William E. Chandler, Secretary of the Navy, in account-current with the United States—Continued.

Date.		Amount.	Total.
	EXPENDITURES—Continued.		
1884. Sept. 25	By bill for tools (saws) required for removing the U. S. ships Colossus and Java. Paid by Pay-Director A. H. Gilman, New York, voucher 87		$49 50
	Cost of breaking up old vessels and removing them.		
	U. S. S. Connecticut, navy-yard, Boston, for labor employed. Paid by Paymaster J. F. Tarbell, as below, viz:		
1883. Nov. 21	Pay-roll for first half of November, voucher 88	$1,574 31	
Dec. 5	Pay-roll for second half of November, voucher 89	2,480 17	
20	Pay-roll for first half of December, voucher 90	2,713 46	
1884. Jan. 4	Pay-roll for second half of December, voucher 91	1,748 29	
19	Pay-roll for first half of January, voucher 92	2,558 12	
Feb. 5	Pay-roll for second half of January, voucher 93	3,423 23	
20	Pay-roll for first half of February, voucher 94	1,928 93	
Mar. 5	Pay-roll for second half of February, voucher 95	1,999 46	
20	Pay-roll for first half of March, voucher 96	317 44	
	Total cost of breaking up the Connecticut	18,743 41	
	U. S. S. Canandaigua, navy-yard, Norfolk, Va., for labor employed. Paid by Paymaster L. A. Frailey, U. S. N., as below:		
1883. Nov. 25	Pay-roll for first half of November, voucher 97	1,909 38	
Dec. 10	Pay-roll for second half of November, voucher 98	2,419 23	
25	Pay-roll for first half of December, voucher 99	1,640 37	
1884. Jan. 10	Pay-roll for second half of December, voucher 100	1,121 48	
25	Pay-roll for first half of January, voucher 101	497 61	
Mar. 10	Pay-roll for second half of February, voucher 102	69 42	
25	Pay-roll for first half of March, voucher 103	167 16	
Apr. 10	Pay-roll for second half of March, voucher 104	334 03	
25	Pay-roll for first half of April, voucher 105	387 52	
May 10	Pay-roll for second half of April, voucher 106	357 00	
25	Pay-roll for first half of May, voucher 107	292 50	
	Total cost of breaking up the Canandaigua	9,196 00	
	U. S. S. Snowdrop, navy-yard, Norfolk, for labor employed. Paid by Paymaster L. A. Frailey, U. S. N., as below, viz:		
Aug. 25	Pay-roll for first half of August, voucher 108	186 87	
	Pay-roll for second half of August, voucher 109	45 02	
	Total cost of breaking up the Snowdrop	231 89	
	U. S. S. Virginia, navy-yard, Boston, for labor employed. Paid by Paymaster J. F. Tarbell, as below, viz:		
Aug. 31	Pay-roll for second half of August, voucher 110 (part)	178 32	
Sept. 16	Pay-roll for first half of September, voucher 111 (part)	47 36	
	Total cost of breaking up the Virginia	225 68	
	U. S. S. Pennsylvania, navy-yard, Boston, for labor. Paid by Paymaster J. F. Tarbell, viz:		
Aug. 31	Pay-roll for second half of August, voucher 110 (remainder)	1,705 25	
Sept. 16	Pay-roll for first half of September, voucher 111 (in part)	5,996 44	
30	Pay-roll for second half of September, voucher 112 (in part)	4,554 61	
	Total cost of Pennsylvania (incomplete) to September 30, 1884	12,256 30	
	U. S. S. Oregon, navy-yard, Boston, for labor. Paid by Paymaster J. F. Tarbell, as below:		
Sept. 16	Pay-roll for first half of September, voucher 111 (remainder)	40 12	
30	Pay-roll for second half of September, voucher 112 (remainder)	2,067 18	
	Total cost of Oregon (incomplete) to September 30, 1884	2,107 30	
	U. S. S. Colossus, navy-yard, Brooklyn, for labor employed. Paid by Pay Director C. H. Eldredge and erroneously included in his accounts and in the general pay-roll of the construction department of the Brooklyn yard, as follows:		
Aug. 30	Pay-roll for August, voucher 113	956 53	
Sept. 30	Pay-roll for September, voucher 114 (in part)	4,535 04	
	Total cost of Colossus (incomplete) to September 30, 1884	5,491 57	

No. 14.—SUMMARY REPORT ON ADDITIONAL VESSELS.

NAVAL ADVISORY BOARD, NAVY DEPARTMENT,
Washington City, November 7, 1884.

SIR: The Board respectfully presents a brief summary of its work in preparing the general preliminary designs of the vessels required in the Department's letter of 21st April last.

The 3,000-ton cruiser is a high freeboard, single-decked, twin-screw vessel, of which the speed is stated to be not less than 14 knots an hour in smooth water, and the maintained sea speed 13 knots. The battery, consisting of four 6-inch and seven 5-inch B. L. R. guns and ten Hotchkiss cannon, all the great guns being mounted on the upper deck; two 5-inch in recessed ports on either bow, under a light top gallant forecastle; four 6-inch guns in sponsons, two to fire right ahead and two right astern; four 5-inch guns in broadside, and one in the stern.

There will be two complete and independent sets of propelling machinery, in separate water-tight compartments, having a maintained collective indicated horse-power of 3,500. The ship will have a bark rig and light head-booms, spreading about 11,000 square feet of plain sail, or two-thirds full sail-power.

The two heavily-armed cruising gun-boats are the same in every respect except the caliber of the guns. They are 220 feet in length, 35 feet beam, and 1,600 tons load displacement. They have twin screws, independent horizontal engines, developing in aggregate 1,600 indicated horse-power, which is expected to give them a speed equal to that stated for the 3,000-ton cruiser. They will be rigged lightly, without head-booms, as hermaphrodite brigs to top-gallant sails.

The battery of one will consist of two 8-inch guns mounted on central pivot carriages at either end of a central superstructure, and two 5-inch guns mounted on the superstructure deck in sponsons forward. In the second, the forward 8-inch gun is replaced by a 10-inch and the after one by a 6-inch gun.

Both these vessels and the 3,000-ton cruiser are protected by inclined steel decks, side coal-bunkers, and careful water-tight subdivision throughout.

The light cruising gun-boat of 800 tons displacement will carry a battery of six low-power 5-inch B. L. R. guns—one on the poop, and one on the forecastle, and four in broadside. A barkentine rig will spread about 5,000 feet of plain sail, which, with a single screw, will make the vessel manageable and useful under sail; but the rig is of such a character that the speed of 10 knots an hour should be maintained at sea under ordinary circumstances. In order to produce these results, and at the same time give a large coal supply of 150 tons, it is considered necessary that the hull should be as light as possible, and therefore to make it of mild steel unsheathed. The machinery and boilers of this vessel will be protected by the coal-bunkers. The boilers will be of a type favorable to the use of forced draught, and at least a speed of 11 knots an hour will be expected in smooth water.

The armed dispatch boat is an unprotected vessel of high speed, and of the size, motive power, and general description of the Dolphin, but

No. 13.—SALE OF OLD MATERIALS.

NAVY DEPARTMENT,
Washington, November 24, 1884.

The Secretary of the Navy in his annual report of December 1, 1883, page 19, stated that sales of condemned stores and supplies had been made at the navy-yards under the authority of the second section of the act of Congress approved August 5, 1882, S. at L., vol. 22, page 296, amounting to about $138,000. This amount was simply an estimate based on incomplete returns. The complete returns, since received, show that from the statutory sales made in the summer and fall of 1883, after paying commissions, advertising, and other necessary expenses, the net sum of $133,406.11 was realized. Of this sum, $127,617.47 were covered into the Treasury under the head of "miscellaneous receipts," in accordance with section 3618 of the Revised Statutes, and $5,788.64 to the credit of the appropriation for "ordnance material and small arms," as authorized by the act of June 20, 1878 (S. at L., vol. 22, page 242).

Sales have been made amounting to $26,005.68 in addition to the above, $10,047.87 of which were from the sale of stores at Rio de Janeiro on breaking up the storehouse in September last. The paymaster is now settling his accounts, and it does not appear that the latter sum has yet been covered into the Treasury.

Two sunken hulks have been sold at Mare Island recently, the net proceeds from which, about $2,400, will be covered into the Treasury as "miscellaneous receipts from sales of Government property." Sales of stores were made this month at Nagasaki, Japan, when the storehouse was closed, but no returns have been received.

JNO. W. HOGG,
Chief Clerk.

No. 14.—SUMMARY REPORT ON ADDITIONAL VESSELS.

NAVAL ADVISORY BOARD, NAVY DEPARTMENT,
Washington City, November 7, 1884.

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The armed dispatch boat is an unprotected vessel of high speed, and of the size, motive power, and general description of the Dolphin, but

carrying a battery of 17 Hotchkiss cannon, which can all be mounted to great advantage on the upper deck. It is proposed to mount the two heaviest revolvers in the extremities of the ship, 12 cannon of various calibers in sponsons on the main deck, and one in each top.

It has been urged, in regard to this vessel, that the armament should I 'e one great gun, say one 6-inch gun, as in the Dolphin; but it is the (inion of the Board that for the class of work which the armed dis- ch will be expected to perform, namely, to attack armed mer- it s ers, the great number of rapid-firing shell-cannon will be (ective, both when directed against the buoyancy by firing at the -ine, or disabling the fire of artillery. This matter has been the ject of careful investigation, and the conclusion reached is in favor (number of high-power, rapid-firing cannon as against the single whose fire is slow and inaccurate, when considered in connec- tn speed of a modern steamer.

It may be objected that the speed stated for these vessels is insufficient, but in each one the weight devoted to propulsive machinery is all that justice to the other qualities of the vessel will permit, and with the present facilities at the service of the Board for determining either the power to be obtained under conditions in many respects new to the naval service, or the efficiency of the power developed in reference to the speed, it is not justified in placing a higher estimate on the speed to be obtained from the present allowances.

THE ARMORED STEEL RAM.

T Board's letter of 4th June, 1884, fully explains its views, namely: it could not advise for construction the ram recommended by the I Advisory Board, which was of the type designed by Rear- A ammen; not approving the position of the ram given by the or c uction, finding the speed which could be obtained for the t nt entirely inadequate and the estimated cost much too small. I the Board would not have recommended the construction of a armed harbor-defense ram whose usefulness even in any event extremely limited, an attempt was made to present the general fea- r of a vessel in accordance with the views of the Department. This idy, short, twin-screw vessel of 3,000 tons displacement, and 17 speed, with a central citadel of 10-inch armor to protect the ma- y and an under-water protective deck, extending from the armored head to the extremities, to protect the buoyancy, strengthen the , d protect the steering gear. The engines recommended for this ip two sets of three-cylinder, inverted-cylinder, direct-acting en- of 42 inches stroke.

boilers will be contained in a small water-tight compartment, le for efficient use of forced draught.

following table gives the general features of each of these vessels, recommended:

Table of dimensions and general features of vessels recommended by the Naval Advisory Board, in compliance with the Department's letter of April 21, 1884.

Dimensions or items.	3,000-ton cruiser.	Second heavily-armed gunboat.	Heavily-armed gunboat.	Armed dispatch-boat.	Light gunboat.	Armored ram.
Length between perpendiculars	290 feet	220 feet		250 feet	175 feet	210 feet.
Extreme breadth	42 feet	35 feet		35 feet	28 feet 6 inches	47 feet.
Mean draught of water	16 feet 10 inches	13 feet 10 inches		14 feet 3 inches	10 feet	17 feet.
Load displacement	3,100 tons	1,600 tons		1,550 tons	800 tons	3,000 tons.
Freeboard	12 feet	5 feet 10 inches		5 feet 10 inches	5 feet	9 feet.
Speed (in knots):						
Smooth water	14	14		16	11	17.
Sea	13	13			10	
Main battery	Four 6-inch; seven 5-inch.	One 10-inch; one 6-inch; two 5-inch.	2 8-inch; 2 5-inch		Six 5″ medium power	
Secondary battery	2.57mm S. 4.47mm Rev 2.37mm R 2.37mm S 2 gatlings	4.47mm Rev 2 gatlings		6.57mm S. H. P 4.47mm S. H. P 3.37mm S. L. P 4.37mm Rev 1 short gatling	2.37mm Rev 1.37mm S 1 gatling	4.37mm. 4 gatlings.
Weight of ordnance	180 tons	100 tons		67 tons	44 tons	10 tons.
Thickness of protective deck	1½ and 2 inches	1½ inches				2½ inches.
Rig	Bark	Hermaphrodite brig		Barkentine	Barkentine	None.
Area of plain sail	11,000 square feet	8,000 square feet		8,000 square feet	5,000 square feet	Do.
Coal capacity	500 tons	250 tons		300 tons	150 tons	
Complement of men	230	120		100	100	
I. H. P	3,500	1,600		2,200	650	
Condition of trial	Six hour	At sea		At sea	Six hour	Six hour.
Revolutions		100		80	100	
Screws:						
Single or twin	Twin	Twin		Single	Single	Twin.
Diameter	14 feet	11 feet 6 inches		14 feet 6 inches	9 feet 6 inches	14.
Pitch	19 feet	16 feet 6 inches		24 feet	12 feet 9 inches	21.
Type of engines	Horizontal, direct-acting.	Horizontal, direct-acting.		Vertical, direct	Horizontal, back-acting.	Vertical, direct.
Stroke	36 inches	28 inches		42 inches	30 inches	42 inches.
Condensing surface	7,000 total	3,200		4,000	1,200	8,000.
Boilers, type of	Cylinder 11 feet 8 inches diameter.	Cylinder 9 by 17 feet 6 inches.		Cylinder 11 feet diameter.	Cylinder side tubes, diameter 7 feet 10 inches.	Cylinder 12 feet.
Grate surface .... square feet	400	182		270	66	
Heating surface .... do	10,000	4,600			1,600	10,000.
Working pressure .... pounds	90	100		100	100	100.
Weight of machinery .... tons	670	435		435	150	750.

Three requests in the Department's letter still remain unanswered. First, with regard to the 4,500-ton cruiser: the Board has now under consideration the preliminary design of a vessel which it has strongly recommended to the Department in the following terms:

The Board has now decided that it will not recommend the construction of another vessel of the size and cost of the Chicago; for this would be to premise that the Navy should be eventually provided with vessels of this class for flag-ships, whereas, the Board is of the opinion that the necessity of providing accommodations for a flag-officer and his staff should not influence the construction of a fighting vessel. The Chicago is a representative of the fully equipped unarmored cruiser, but it is believed that the same fighting efficiency can be obtained without the sacrifice of any qualities essential to a war vessel, and at much smaller first cost and expense of maintenance, by the construction of a fast twin-screw steam cruiser of the type of the Boston and Atlanta, of about 3,600 tons displacement. This vessel should carry some armor-piercing guns, which should be rendered useful and effective by a speed far surpassing that of most iron-clads, at least 16 knots an hour in smooth water. The ship should be protected by a steel deck extending throughout the whole length, and by the careful subdivision of the space above and below it, and of the coal-bunkers. By the adoption of twin-screws, and two complete and independent sets of machinery, and perhaps a further subdivision of the boiler compartments, with a view to the use of forced draft, the Board feels justified in recommending that the use of sails as a means of propulsion be entirely abandoned in this vessel. The Board is aware of the objection that will be urged against this action, that owing to the lack of coaling stations abroad it is exceedingly important that sails should be retained in order that vessels may cruise under sail, and thus maintain themselves longer at sea.

This only forces the single conclusion that coaling stations must be provided, for there is hardly a doubt but that the Chicago, at sea under sail alone, would be the prey of an antagonist of one-third her size, approaching under steam, in these times of high speed.

The Board is now proceeding with the consideration of the design of the vessel herein recommended. If, however, the Department wishes to be advised concerning the design of a 4,500-ton fully equipped cruiser, then the Board will recommend that the Chicago be duplicated throughout, except in some minor improvements in detail of arrangements, scantlings, &c.

TORPEDO-BOATS AND TORPEDOES.

In the designs of these vessels, as in the cruisers now building, the Board has made allowances for the use of an automatic fish torpedo of some kind; but has recommended that the *ship's* spar torpedo outfit, as fitted in the United States naval vessels, should be omitted, as in the opinion of the Board it does not add to the fighting efficiency.

In regard to advising the Department concerning the three torpedo-boats, the Board found that torpedo-boats for naval attack, coast and harbor defense of all European nations, are now designed to use the Whitehead torpedo alone. Also, that the boats must be built with special reference to the use of some torpedo, and as the only one in use by the United States was the spar, the Board inquired if these boats were to be designed for its use. The reply was indefinite, and no action was taken; but now the Board is prepared to make definite recom-

mendations, as it is considered that the importance of the matter demands prompt action.

Recent reports show that American inventions of automatic fish and projectile torpedoes possess great merits, and bid fair to become, at reasonable cost, powerful and useful weapons, but at the present moment the only torpedo in the world that has passed through all the experimental stages, and is in the market for sale as a completed weapon of war, is the Whitehead.

The subject of a completely organized torpedo-boat coast defense has been attracting a great deal of attention in Europe for a number of years, and now is considered indispensable. They are intended to form a middle line of defense or coast patrol between the forts and fixed mines inshore, and the monitors and coast defense vessels outside. At present this middle line is in a fair way of becoming considered as the most important of the three lines of defense.

Germany is leading in this direction, and will shortly be in possession of 150 of these craft (about $4,320,000 worth), or one for nearly every ten miles of coast, which distance the boat can traverse in half an hour in any weather in which an iron-clad dare approach.

The coast of the United States is admirably adapted for this kind of warfare, and it is deemed by the Board to be of great importance that a commencement should be made with reference to it; but before making large expenditures, it is necessary to determine the proper type of boat, and to make a thorough investigation of the different torpedoes adapted to naval purposes.

The Board would recommend as follows:

1. That $100,000 be appropriated for the purchase of the right to use the Whitehead torpedo, and of a certain number of completed torpedoes.

(2) That $150,000 be appropriated to build by contract one first-class torpedo-boat 130 feet long; one first-class torpedo-boat 110 feet long, and one second-class torpedo-boat 70 feet long, all fitted to carry the Whitehead torpedo, and the contracts to stipulate a penalty if the results of foreign boats are not obtained, and a premium if they are exceeded.

In regard to the armored vessel, the Board is decidedly of the opinion that the United States should be in possession of a first-class sea-going battle-ship, namely, a vessel that should be armed with the heaviest guns, protected with the heaviest armor, and provided with the maximum engine power now considered attainable in a vessel of not unwieldy magnitude. While disposed to recommend such a design to the Department, the Board finds on investigation certain insuperable natural obstacles to the use of such a vessel on the Atlantic coast, and which limit the value in even the deep-water harbors of the Pacific.

It is essential that even a vessel for operations on the high seas should be able to enter our principal ports and naval stations for supplies, repairs, &c., at any state of the tide. Investigation proves that this condition would limit the maximum draught of water to twenty-three feet.

Again, the dimensions of the vessel must be governed, unfortunately, by the size of our dry-docks. That building at Mare Island is the only one that would admit a first-class iron-clad, while the docks at Boston and Norfolk limit the extreme breadth to about 58 feet.

Therefore, with an absolute limit on two dimensions, the requisites for handiness that a vessel should not exceed 300 feet in length, for a certain degree of fineness of form which is essential to speed; these, combined with two other governing qualities of the large margin of stability and the space for well-protected machinery, would fix the maximum

displacement for vessels of this type for the United States Navy at about 7,000 tons.

The requirements of our service are peculiar and the qualities of an iron-clad require most careful adjustment, but the Board expects to forward to the Department a preliminary design at an early date.

Very respectfully,

E. SIMPSON,
Rear-Admiral, U. S. N., President of the Board.
HENRY STEERS,
Naval Architect.
ALEX. HENDERSON,
Chief Engineer, U. S. N.
J. A. HOWELL,
Captain, U. S. N.
F. M. BARBER,
Lieutenant-Commander, U. S. N.
F. L. FERNALD,
Naval Constructor, U. S. N.

Hon. W. E. CHANDLER,
Secretary of the Navy.

COMPLETION OF MONITORS.

Estimated weights and cost of armor required.

	Puritan.				Amphitrite and class.			
	Weight.		Cost per pound delivered free of duty.	Total cost.	Weight.		Cost per pound delivered free of duty.	Total cost.
	Tons.	Pounds.			Tons.	Pounds.		
			Cents.				*Cents.*	
Side armor	737.4	1,651,854	22.5	$371,667 15	355.6	796,551	21.0	$167,275 71
Fastenings	22.3	50,000	30.0	15,000 00	13.4	30,000	30.0	9,000 00
Turret armor and pilot-house	264.3	592,108	25.2	140,120 60 9,090 60	208.9	468,048	25.0	117,012 00
Smoke-pipe armor	72.8	163,211	22.0	35,906 42	35.7	80,160	22.0	17,635 00
Ventilators	33.5	75,247	22.0	16,554 34	17.4	39,188	22.0	8,621 36
Total	1,130.3	2,532,420	23.2	588,339 11	631.0	1,413,947	21.8	319,544 07

REMARKS.—The cost of armor includes the cost of fitting to the ship. For cost delivered, ready to be fitted, see below.

Summary of weight and cost of armor required.

	Weight of armor.	Cost per pound delivered ready for fitting.	Total cost.
	Tons.	*Cents.*	
Puritan	1,108.0	21.9	$543,540
Amphitrite	617.6	21.3	294,411
Terror	617.6	21.3	294,411
Monadnock	617.6	21.3	294,411
Total	2,960.8	21.5	1,426,773

REMARKS.—The cost per pound is free of duty and ready for fitting. Cost of fitting, $25 per ton.

No. 15.—TRIAL OF THE DOLPHIN.

NAVAL ADVISORY BOARD, NAVY DEPARTMENT,
Washington City, November 24, 1884.

SIR: The Board would respectfully report that it was notified by t contractor, Mr. John Roach, that the Dolphin would be ready on tne 20th instant for the preliminary trial to test the machinery, engines, boilers, and appurtenances, as required by the ninth clause of the contract. This trial was to be made, as recommended by the Board in its letter to the Department of 11th September, in Long Island Sound, and the data to be recorded as required by the United States Steam Log, and as approved by the Department in a letter to the Board of 25th October.

The contract conditions were as follows:

"(2) That the collective indicated horse-power developed by said engines under the prescribed conditions shall be 2,300, and maintained successfully for six consecutive hours; provided, that in case of the failure of the development of this power the vessel shall be accepted if it can be shown to the satisfaction of the Naval Advisory Board and the Secretary of the Navy that this failure was due neither to defective workmanship nor materials."

The Board assembled on the Dolphin at 8 a. m. on the 20th instant, at the dock in East River, at the foot of Eighth street.

The ship left the dock at 9.15 a. m., and proceeded at two-thirds power into the Sound. At 10.46 a. m. she passed Execution Rock Light at full speed; the agreement being to run as nearly as possible a straight course at full speed to the Middle Ground Light, 30¾ miles distant, and as far beyond as necessary to occupy a time of three hours, in order that six hours might expire on the return to Execution Rock.

At 12^h 40^m 10^s the engines slowed down for twenty minutes to examine a bearing. With this exception the engines worked continuously, the boilers furnished ample steam, the fire-room blowers furnishing excellent draft, until 2.36 p. m., when the vessel, having fallen off four points while turning at full speed to return, the thrust length of the main shaft broke just at the neck of the coupling abaft the main bearing.

No damage further than a slight injury to the bearings of the broken length of shaft was done to the machinery; and the vessel then came to anchor, lying 4 miles southeast of Falkner's Island Light, and assistance was sent for.

The Board is gratified to state that except for this accident the vessel would have been recommended for acceptance, as the average collective indicated horse-power of the engines was 1,954 and the maximum 2,141; the average speed over the ground for the whole distance of 55.7 nautical miles run was approximately 15.3 knots per hour.

The Board estimates that the speed through the water for one hour, for which more accurate observations were obtained, was at the rate of 16 to 16¼ knots.

The trial was sufficient to convince the Board that the vessel will fully meet the estimates of her design when a continuous trial is obtained after the shaft is replaced.

After further investigation, the Board will inform the Department in regard to the probable cause of the failure of the shaft, which under the terms of the contract is to be made good by the contractor.

Very respectfully,

E. SIMPSON,
Rear-Admiral, U. S. N., President of the Board.

Hon. W. E. CHANDLER,
Secretary of the Navy.

No. 16.—REPORT ON TESTS OF MILD STEEL: SYNOPSIS.

NAVAL ADVISORY BOARD, NAVY DEPARTMENT,
Washington City, November 17, 1884.

SIR: The Board would respectfully state that it has in preparation a "Report on Tests of Mild Steel" for the cruisers, in general accordance with the accompanying synopsis.

The report cannot be completed for some months, when it is hoped that it may be embodied in the volume of your report for the year 1884.

Meanwhile it is desired to state that although some trouble was naturally experienced in the beginning, the measure of success obtained by the steel manufacturers in meeting the specifications is very gratifying, while the specifications themselves have effectually secured the requirements of the law, viz, "a tensile strength of not less than 60,000 pounds to the square inch, and a ductility in eight inches of not less than 25 per centum."

The material furnished up to September 1, in all about 4,570 tons, shows an average tensile strength of 62,700 pounds per square inch, with 25.75 per cent. ductility in eight inches.

The success obtained in working the material in the ship-yard is no less gratifying, the proportion of failures of material under treatment being extremely small.

It is with pleasure that the Board reports the progress made in mild steel construction, which in future should present no especial difficulty, and the entire feasibility of which, at moderate cost, has been completely established.

Very respectfully,

E. SIMPSON,
Rear-Admiral, U. S. N., President of the Board.

Hon. W. E. CHANDLER,
Secretary of the Navy.

SYNOPSIS.

Résumé of the proposed report of the Naval Advisory Board to the honorable the Navy on tests of steel.

This report is prepared and compiled by the Board in order to render more useful the mass of information accumulated during the first experience of the Department with mild steel for naval construction; thus to further the development and manufacture and use of this metal.

1. Résumé of the discussion and testimony leading to the adoption of the limits of strength in Act of August 5, 1882, including the testimony before the Committee of Naval Affairs in the House, and the report of the first Advisory Board.
2. This Board's letter to steel makers of the 21st March, 1883, asking if they could supply shapes under this act.
   Their replies in full.
3. Tests as first drawn up by the Board.
4. Letter forwarding this to steel makers; remarks noting replies.

5. Board's letter on proposed modifications, explanations of this and comparisons with foreign and other tests.
6. Tests as finally approved by the Department.
7. Difficulties found in use, and cause of same, and subsequent modifications of methods of inspection.
8. Tests of each heat from each place from which steel has been supplied, and summaries, as follows:
Total number of heats tested.
Total number of heats passed.
Total number of heats failed.
Average tensile strength of whole amount passed.
Average ductility of whole amount passed.
Total amount of material delivered to September 1, 1884.
Weight of finished material failed in quenching.
Weight of finished material failed in per cent. of pounds of material subjected to this test.
9. The above given for totals, delivered, passed, &c., from all mills in aggregate.
10. Table showing nature and cause of failure of every piece which failed in working or was rejected at the works, and the per cent. of this to the total amount delivered.
10 *a*. Summaries and tables, similar to the above, of tests of rivets.
11. Board's letter asking a report from each inspector as to changes or additions to the tests.
12. Copies of each of these reports.
13. Tests finally proposed by the Board, with reasons for same.

SPECIAL TESTS.

1. Tests of steel shafts accompanied by tests of steel for shafts taken from other sources.
2. The special reports of each inspector of tests for elastic limit with strain diagrams, accompanied by discussion of the results, and by remarks on testing machines.
3. Tests showing Board's experience with annealing.
4. Tests of ductility and tensile strength of specimens of various lengths from ½" to 10".
5. Table of calculated strength of beam sections.
Discussion of variation in the sections for different places and purposes.
6. Recommendations that Z bars of certain sizes should be specified for frames and other uses.
7. Tests of steel forgings for cruisers.
8. Instruments for use in testing.
Blanks for use of inspectors, &c.

No. 17.—EXPERIMENTAL WORKS TO DETERMINE RESISTANCE OF SHIPS.

NAVAL ADVISORY BOARD, NAVY DEPARTMENT,
Washington City, April 17, 1884.

SIR: The Board respectfully recommends that experimental works be established for the purpose of determining the resistance of ships by towing models, having needed the results obtained by such experiments since the commencement of its present labors.

With reference to the utility of such an establishment, the Board has only to point out that the most important question in naval architecture is the relation of resistance, speed, and engine power of ships, and that such experiments as are herein suggested in connection with measured mile trials such as the Department has already authorized are now regarded as the means by which a solution of this question may be most nearly approached.

The Board presents herewith a memorandum submitted by Assistant Naval Constructor F. T. Bowles, presenting a brief résumé of the history and advantages of such an establishment, including a copy of his paper on towing experiments on models to determine the resistance of full-sized ships, and a letter to him from Mr. William Denny, of Dumbarton, giving valuable information in regard to this matter.

The Board suggests an appropriation of $50,000 for the construction of the tank, buildings, engines, instruments, and attachments, to be situated at the Washington navy-yard.

It is estimated that a year would be required for the completion of the structure and instruments.

Very respectfully,

E. SIMPSON,
Rear-Admiral, U. S. Navy, President of the Board.

Hon. W. E. CHANDLER,
Secretary of the Navy.

No. 18.—REPORT ON TORPEDO-BOATS FOR COAST DEFENSE.

PARIS, FRANCE, *August* 26, 1884.

Of all the special branches of naval equipment, none is at present receiving a more careful and wide-spread attention amongst the European naval powers than that of the torpedo-boat for coast defense. Every country, without exception, that possesses a sea-coast is at this moment engaged in building. or having built, boats suitable for this service. Portugal alone, of all these countries, possesses less than nine boats competent to take part in coast defense. (In the use of the word *coast*, its literal definition is intended.) Every evolutionary squadron has its attachment of torpedo-boats forming an independent flotilla, fully able to accompany the squadrons under all circumstances of wind and sea. In all countries officers are picked from the lower grades of the executive corps, and are given a special training in handling them, to acquire an intimate knowledge of every detail of the boats and of their native coasts. The crews form a picked corps of men thoroughly instructed in the working of the machinery and weapons, and with but one or two exceptions each nation builds its own boats.

The unanimity with which foreign naval powers are developing topedo warfare seems to prove that decided recommendations should be made with regard to torpedo-boats.

In making a report upon torpedo-boats for coast defense it seems best to start from the basis of the recommendations of a board of German naval officers, made in March last to the Reichstag. It must be borne in mind, 1st, that in 1873 a German advisory board laid down a complete programme for the reconstruction of the navy; 2d, that as this programme has been filled, it has been accompanied by constant practical tests which have led to many modifications of detail, although the main summary has never been deviated from; 3d, that no deviation has ever taken place upon theoretical considerations alone, but only after direct experiment has clearly proved that a strict adhesion to the original projects was erroneous. The following extracts from the report above referred to contain all that is pertinent to the subject under consideration:

The development of submarine mines and of locomotive torpedoes has at present reached such a point that we do not expect important advances to be made in either system during the coming year, and, such being the case, we are of the opinion that we should now acquire the best material existing for both systems. For many years we have patiently allowed other navies to take precedence of ours in this development, in order that when the proper time should come to fully equip this branch of the service we might be absolutely certain of advancing in the true direction. That time has now come, and we must cease observation and proceed at once to the complete defense of the German coast. * * * The idea which was formerly cultivated, and which was expressed in the original programme of fleet development, of having special torpedo vessels of a medium size, has not been realized, and is not recommended on account of the many obstacles presented by the attempt to satisfactorily combine speed, armor, maneuvering power, torpedo and gun power. * * * The design of providing each iron-clad with two torpedo-boats has as yet not been fully carried out, as it is considered better, if possible, to make these boats larger and more seaworthy, in order that they may accompany an iron-clad squadron as an independent attachment.

For fighting along the home coast these boats will be able not only to accompany the iron-clads but to engage in independent coast operations. For foreign expeditions, too distant to make them independently applicable, they may be transported to the scene of action on special transport ships.

Torpedoes, as well as torpedo-boats, are now manufactured exclusively in native German establishments. * * * These boats are about 98 feet in length, with very light draught, carry a complement of one officer and about fourteen men, two torpedo-dischargers, and, as a rule, two revolving cannon. They have no rig whatever, but carry coal enough to drive them 1,000 miles, at a speed of 10 knots. The few boats of this class which the German Government has possessed up to this time (eleven in all) have been well taken care of. * * * The small size and very high speed of these boats make them very difficult targets to hit, so that in this respect they possess a great advantage over heavy iron-clads. * * * It must be remembered, however, that it is not probable that the success of an operation would be made dependent upon a single shot or a single boat, but that attacks would be made by from two to six boats, attacking from different directions. It is possible, therefore, at the risk of a loss of a minimum number of men and of a few cheap and quickly-built boats, to sink a colossal war-ship in a single attack. Even in bright moonlight, and with the greatest possible care and alertness, it becomes impossible for a ship to anchor for a single night on a coast well defended by these torpedo-boats.

Numerous and well-provided torpedo-boats make a blockade an undertaking of the most difficult character. It makes it necessary for the blockading squadron to haul off the coast every night. Its coal supply is thereby wasted, the harbor is left open at night, and the actuality of the blockade is threatened. Even though under way the squadron is not safe, for the boats can follow it out and find the ships.

It is readily conceivable that in an energetic defense of this kind many boats will be disabled through accident and the enemy's fire, and therefore the total number of boats must not be limited to that barely necessary for the active work. * * * In considering this matter it is not a question of any single modification of type, or of single vessels, as would be the case with vessels of the fleet, but it is a necessity that the German torpedo flotilla should be brought up to the number of 150 boats, for coast defense, the armament of war ships, and a reserve for replacing disabled boats.

With this number the German fleet will stand first in the world in respect of torpedo defense, as is shown by the following table of torpedo-boats possessed by different nations:

England has built 22 first-class and 97 second-class, and is building 4 first-class and 6 second-class—total, 129.

France has built 13 first-class and 53 second-class, and is building 3 first-class and 7 second-class—total, 76.

Russia has built 4 first-class and 117 second class, and is building 4 first-class—total, 125.

Italy has built 18 first-class and 21 second-class, and is building 14—total, 53.

Holland has 24, Norway and Sweden 15, Austria 14, and Denmark 9. England, France, and Austria contemplate an increase in the immediate future.

The average cost of a torpedo-boat, with its torpedoes and revolving cannon, amounts to 240,000 marks ($57,170). In order to attain this number of boats it is necessary to provide for building 115 new ones.

The opening statement and the final recommendation of this report leave no doubt whatever with regard to the opinion of German naval officers that the torpedo-boat has passed entirely beyond the experimental stage, and has entered as a permanent element into the constitution of the fleet. As they say, there is no question here of types of vessels or of single ships, but the flotilla must at once be brought up to its full standard. Coming as these statements do, from a people so methodical and certain in all matters of military improvement, it would seem that an acquisition of these boats by the United States is of the *first* importance, and that action should be taken at once.

In entering into an argument with regard to the importance of this type of naval defense for our own coasts, it is necessary to have as complete an understanding as possible of the boat itself and its development. The appendix to this report contains important data, illustrating the improvements and present condition of the boats.

From these data it will be seen that the fully developed first-class torpedo-boat of to-day is in general terms a craft about 100 feet long, with a draught of from 4½ to 6 feet of water; a capability of maintaining a

speed at sea of not less than 16½ knots; an endurance at this speed of over 150 miles, and a maximum endurance of from 650 to 1,200 miles; an armament of torpedoes and revolving cannon, and a capability of keeping the sea under all conditions of weather.

In examining the especial work of this type of boat, attention is drawn to the custom now almost universal in Europe of considering the total work of the coast defense as divided into three distinct sections, called lines of defense.

The inner line consists of the coast fortifications and other channel defenses, such as mines and permanent obstructions. Indefinite extension of fortifications, such as would render the coast difficult of access, is impracticable. The great expense of construction and maintenance limits their position to those points which are of the most vital importance to the safety of our seaboard towns. Even at these points the best armed fortifications are considered insufficient of themselves to effectually check an active enemy from doing almost irreparable damage to the places which they are designed to protect. In order to enable them to develop their full power a defense must be organized in the approaches themselves. In the cases of approaches that possess little commercial but great strategical value, these supplementary defenses may consist of permanent obstructions, blocking the channels completely and needing only such protection as shall insure against their removal by an enemy. In approaches of great commercial value, this system cannot be applied except at a period of the most dire necessity. The channels must then be defended by mines. These mines, however, must not be of such a nature as to hamper the free movements of friendly commerce or naval vessels except when the enemy is actually present, and the matter of opening or closing channels at will is one of the most difficult things to accomplish, particularly with an active enemy in the vicinity, who, by skillful countermining, may in a single night make a havoc in these defenses that it will require days and perhaps weeks to remedy, requiring resort to permanent obstructions.

In order that these important approaches may be kept open until the last moment, that time may be gained by giving warning and possibly holding an enemy in check until they may be made secure and to prevent their removal or disabling when in place, a second line of defense is rendered necessary. As it is this line which depends for its main strength and effectiveness upon torpedo-boats, I will pass to the consideration of the outer line first.

The outer line of defense consists of the sea-going fighting vessels proper, both armored and unarmored. If an armored force appears before any important point on the coast, it must be met by a force of at least equal strength and driven off, otherwise a blockade is established. It must be borne in mind at this point that, if a channel is blocked by our own mines or obstructions, the object of a blockade is fully attained, so that an enemy is really relieved of the necessity of keeping a strong blockading force in the vicinity; and in points where his strong force is present, these mines and obstructions are a most powerful aid to that force. There are many methods of modifying this drawback, but none can neutralize it except in a very partial manner without the assistance of the middle line of defense. An enemy's force acting in squadron requires a massing of the vessels of the outer line into squadrons to act against it. An active enemy using vessels singly requires the most constant movement of the individual vessels of the outer line to keep him off. In these cases a single vessel may keep several constantly confined to one portion or stretch of coast to

guard it. Thus the outer line is rendered liable at any time to be off from even the defense of a most important point, to meet and c or drive off a concentrated movement at some other point.

Coming now to the second or middle line of defense, we find its d to be: To inaugurate a living defense of the approaches, that ca guish friend from foe; that shall by its mobility and strength e bar the way to the sudden incursions of single vessels of the en permitting commerce to freely pass in and out up to the last ; that shall assist the fortification to guard the mines from counter ing; that shall leave the ships of the outer line the greatest freedom in movement, so that their sudden withdrawal at a call or in ch not leave a point open to attack; that shall finally render a b by the enemy a hazardous undertaking, forcing him to haul off the at night; and that shall prevent him from taking up a position for bardment out of reach of the fortifications and mines, and, in *mêlée* on the coast between squadrons, that can advance d t

To keep the approaches constantly barred to the enemy friends is the specific duty of the coast defense. It is of the the world over, being unaffected in this respect by either the pol or geographical situation of the country. In the United States, ever, the *importance* of this part of a war programme is superior to of all others, since in a war with any country except England or Me the first attack on national territory must be on the coast, and England the danger to the coast is greater than that to the North border. Naturally, then, in developing a defensive power, the c defense should receive the first attention.

Examining the present condition of our coast defenses, it will be found that the inner line is the best provided. Whatever may be the deficiencies of the fortresses, the channel protections can quickly be made available. Technical knowledge is here of far more vital importance than actual material, and, thanks to the schools of Newport and Willets Point, the United States is in a position to hold its own with the world, so that in case of an outbreak this part of the defense could be quickly and effectually put in operation, and thus be of great service in allowing time for the full development of the other lines.

As has been shown, however, this channel protection is open to destruction by an active enemy, and requires a vigilant guard, just as much as an army requires outposts.

Attention is here called to an invention now regarded with great favor, which has been introduced in Germany, France, and Austria, and for the purchase of which Italy is negotiating. It is a system of mines (the invention of an Austrian naval officer), that may be laid down by a vessel running at slow speed in such a manner as to effectually close an approach. The system may be taken up almost as quickly as it is laid down, and in this manner approaches may be left free until the danger is actually in sight.

Passing to the outer line of defense, it is found to be lamentably weak, although it exists to a certain degree and gives evidence of development. This line is, however, one that cannot be quickiy established. Years are required to build a single iron-clad, and it is almost beyond possibility to arrive at the construction of more than one at a time during peace. With regard to the unarmored vessels, we have yet to test the amount of their value (which seems to be very great) in this line, as it will probably be several years before enough of them will be afloat to make any effective combination whatever.

The second line of defense in all navies consists of torpedo-boats, with what are known as floating gun-carriages and torpedo-gun boats

as supporters. This line with us has, in point of fact, no existence whatever, although the weakness of the first line, the time required in war to strengthen that line, the innate power of the second or middle line itself, and the necessity of its existence as a guard over the inner line, all imperatively demand its development. Without the existence of an outer line the middle and inner ones can keep the enemy off, break a blockade, and frustrate operations. With the partial development of a middle line, concentrations can readily be made that will enable the inner line to be developed with the greatest speed. Without the middle line our outer line is utterly powerless to spread its support, and the inner one is in constant danger.

In scanning the coast defense development all over Europe, it will be found that, whilst the fortresses are incomparably stronger than our own, their strengthening has been of a very gradual nature, and, as artillery improves, the rearmament of the coast forts is the last strengthening carried out.

The channel defenses, being a matter mainly of technical education, cannot be measured in its development, and in so far as the education is concerned we are not behindhand. In the outer line, our attention has been constantly turned to the construction of the great iron-clads. The fleets are large, and immense expendures are made to increase their number.

Considering the second or middle line, we find nearly every navy in the world with a full schedule of floating gun-carriages and torpedo-gunboats, the result of a constant growth since 1869. With the torpedo-boats, however, the development becomes at once strikingly marked. In 1873 there was one builder in the world (Thornycroft). In 1883 we count as builders exclusively devoted to this work, two in England, two in France, three in Italy, three in Germany, two in Russia, and one in Austria. To induce such a rapid increase there must be a powerful support. Within the past *year* we find Government orders given for not less than 90 first-class torpedo boats of over 90 feet length. Finally, we find the youngest and most enterprising naval establishment of the world (Germany) devoting almost one-fourth of its entire naval appropriation ($4,000,000) to the immediate construction and equipment of 70 torpedo-boats, with an additional demand for 45 more to be constructed as soon as these are finished.

It is evident, therefore, that in our naval development the coast defense is of vital importance, and that the middle or torpedo-boat line requires the very first attention.

In determining the amount of material and its cost necessary for an efficient constitution of this second or middle line, it seems best to first make an estimate of the war strength absolutely requisite. Having this and knowing the time required to build and fit out a single element, the requisite peace strength may be deduced which is necessary for creating sufficient technical and practical skill for war emergencies, and for distributing a proper degree of building skill which will make it possible to quickly raise the strength from a peace to a war footing.

The first step in this investigation is evidently the most difficult one, as, aside from the fact that ideas differ widely as to what the United States should consider a war strength in any detail, positive experience is lacking as to the exact strength of the individual torpedo-boat as measured by its capability of keeping the vessels of an enemy at a distance.

In making an estimate the following limitations have been observed:

1st. Weight has been given to the probable support of gunboats,

vessels of the outer line, and steam-launches in support of the torpedo-boats during their different services.

2d. Only the defense of the most important commercial centers, naval depots, and entrances to water routes are allowed for, and the torpedo-boats are supposed to be collected in divisions at these points to perform work in the immediate vicinity. Such would certainly be the first disposition on the outbreak of war.

3d. The divisions are supposed to be able, at need, to furnish a certain amount of mutual assistance and re-enforcement within certain limits, these limits being the boundaries of coast defense districts, and the divisions thus furnishing mutual support forming independent flotillas.

4th. Three boats are considered as forming the smallest division that can do effective work under the majority of circumstances.

5th. The mean size of these boats is considered to be represented by the French and German 98-foot boats, which are the smallest ones thoroughly capable of acting independently in all weathers and positions. In estimating the complements required for these boats, one officer is allowed to each, a full crew of fourteen men to each active boat, and half crews to each reserve one.

The reasons governing the assignment of certain numbers of boats to each division have been carefully considered, and each number has been fixed only after a careful consideration of the circumstances connected with the defense of each place. The summary is as follows:

Estimate of minimum war strength in torpedo-boats required for the coast defense of the United States.

Districts.	Divisions.	Boats. Active.	Boats. Reserve.	Officers.	Men.
1st.—Gulf of Maine	Portland	3	1	4	49
	Boston	4	4	8	84
	Cape Cod Canal	3	1	4	49
	Flotilla strength	10	6	16	182
2d.—Long Island	Buzzard's Bay	4	1	5	63
	Narragansett Bay	4	4	8	84
	Long Island Sound	4	1	5	63
	New York Bay	8	4	12	140
	Flotilla strength	20	10	30	350
3d.—The Bay	Delaware Bay	8	4	12	140
	Chesapeake Bay	8	4	12	140
	Flotilla strength	16	8	24	280
4th.—The Carolina	Wilmington	3	1	4	49
	Charleston	3	1	4	49
	Savannah	3	1	4	49
	Flotilla strength	9	3	12	147
5th.—The Gulf	Florida Keys	8	4	12	140
	Pensacola	3	1	4	49
	Mouths of Mississippi	6	2	8	98
	Galveston	3	1	4	49
	Flotilla strength	20	8	28	336
6th.—California	San Francisco Bay	4	4	8	84
7th.—Northwest	Columbia River	3	1	4	49
	Puget Sound	8	4	12	140
	Flotilla strength	11	5	16	189

Accepting 90 torpedo-boats as the minimum number to provide effective means of defense in time of war, to what extent may this number be economically reduced and still render it possible to attain the full strength in time to prevent an enemy from profiting by the reduction?

In the first place, all wars that have occurred, during the past fifty years certainly, have practically proved that naval hostilities produce decisive results in less than three months from the outbreak of hostilities. Secondly, in order that boats should be built with adequate rapidity, a knowledge of the special building requirements is absolutely necessary, and this knowledge scarcely exists with our mercantile builders at present. Thirdly, the effective management of these boats, and the peculiar nature of the service, make of it an important specialty of the naval officer's profession. This special knowledge can only be obtained by extended practice, and falls entirely outside of the capabilities of those who have not received a thorough practical training. In case of a war, when the *personnel* of the Navy would be suddenly increased, neither the volunteer fireman, machinist, nor officer would be fitted. The *personnel* of this branch must be made up of picked men, thoroughly trained. Lastly, to superintend the very rapid building of these boats officers and men must be detailed to watch and superintend the construction, that they may be familiar with every detail.

To determine a peace strength that will furnish the necessary instruction to builders and *personnel*, the reserve may be struck out without disabling the force, and the points to be defended may be divided into two categories according to the degree of importance and probability of attack within the time allowed for strengthening the entire flotilla. By withdrawing the defense of the points of the second category, leaving them to the defense of the inner line, with a chance of aid from the boats retained in the first category, the following reductions may be made:

Flotilla strength.	Division.	No. of boats.
First district	Boston	4
Second district	Narragansett and New York	12
Third district	Delaware and Chesapeake (one-half)	8
Fourth district	Charleston	3
Fifth district	Mississippi	3
Sixth district	San Francisco	4
Total		34

This estimate gives a peace strength equal to less than one-fourth of the war strength, and this strength properly handled could, without doubt, make itself of inestimable value in keeping an enemy at a respectful distance during the first months of preparation.

Thirty-four boats being considered the least number proper for a peace establishment, the highest interests would seem to be served in providing them at once, as is the case with Germany. But our builders (having had no experience in this work) could not meet such a demand, and it would be very difficult to secure a sufficient appropriation for the object. A sufficient number, however, should be purchased from European manufacturers to serve as models and to provide a sufficiently large flotilla with which to commence the training of officers and men.

In this way not only is a boat of the most improved pattern in every respect secured, but, what is of more value, working drawings will be

secured which would be of the greatest aid to builders. Again, provision must be made in arranging for building ourselves, to as far as possible gain the power for each coast district to provide its own boats. The immense extent of the coast and amount and variety of the work to be done in establishing a thorough defense makes this all-important.

Very respectfully,

EDWARD W. VERY,
Lieutenant, United States Navy.

Hon. WM. E. CHANDLER,
Secretary of the Navy.

APPENDIX.

The table at the commencement of the following description is arranged for the purpose of giving a preliminary idea of the general steps followed in the development of the size, speed, endurance, and power of torpedo-boats. Five examples are chosen as type models, as follows:

1st. Boat No. 1, the first special fast torpedo-boat ever built, designed and constructed by Thornycroft for the Norwegians.

2d. The Lightning, the first boat ever built for harbor and coast work of an independent nature. Designed and constructed by Thornycroft for the English.

3d. The normal second-class boat as now built, to form a part of the torpedo armament of iron-clads and heavy, unarmored cruisers.

4th. The Batum, the first cruising torpedo-boat ever built. Designed and constructed by Yarrow for the Russians.

5th. The Suchum, the largest cruising torpedo-boat as yet built, and considered to represent the maximum size to which the unarmored boat will be carried. Designed and constructed by Thornycroft for the Russians.

Development of the torpedo-boat.

Name.	Date of building.	Length.	Beam.	Draught.	Displacement.	Maximum speed.	Horse-power.
		Feet.	*Feet.*	*Feet.*	*Tons.*	*Knots.*	
Boat No. 1	1873	57	7½	3 mean	5	14.94	90
Lightning	1876	84½	10½	5 mean	25	19.4	350
Normal second class	1881	63	7½	3$\frac{7}{12}$ aft	10½	17½	150
Batum	1880	100	12½	4 aft	48	22.16	500
Suchum	1883	113	12½	6 aft	59½	19.49	750

Name.	Steam pressure per square inch.	Revolutions.	Coal supply.	Endurance at 10 knots.	Armament.
	Pounds.		*Tons.*	*Knots.*	
Boat No. 1	85	453	1	80	1 towing torpedo.
Lightning	110	500	5	....	3 Whitehead torpedoes.
Normal second class	113	554	1½	....	2 Whitehead torpedoes.
Batum	130	392	5	450	4 Whitehead torpedoes.
Suchum	130	415	10	1,000	4 Whitehead torpedoes. 1 Hotchkiss 37-millimeter gun.

The Norwegian boat differed radically in every respect from any other fighting boat **that had ever** been previously built, thus furnishing a distinct type. Her peculiarities **may be** summarized as follows: Steel frames and plating; great length in proportion **to beam**; no shear at all; extremely fine lines; division into six water-tight compartments; **complete** deck covering; compound engines with independent pumps **and surface condenser**; forced draft under the grate-bars; and the screw abaft the **rudder.** Her **armament** was a towing-torpedo somewhat similar to the Harvey, which, **it will be remembered, was** the most popular of the naval torpedoes in 1872-'75.

In so far as the general model of the boat is concerned no alteration has taken place of any note since that time. Up to about 1880 all boats had vertical stems, but since then the invariable rule has been to give them pronounced and strengthened ram-bows. This modification was introduced as a result of the bad ruptures to the bows of several boats which had collided. There has been one exception to this rule which developed a point worthy of notice. Shortly after the construction of the Batum the Danes ordered a similar boat. On her trip from London to Copenhagen it was found that the swell of the lines of the ram-bow, occurring just forward of the mouths of the torpedo-tubes, carried the water up against the tube-stoppers, interfering with the boat's speed and steering power. When, the next year, the Danes ordered the Delfinen (a sister boat) they gave her a straight stem, so that the mouths of the torpedo-tubes came almost abreast the stem-post. It was found that this alteration entirely cured the bad water-lift. However, since that time improvements have been made so that at present the tubes do not project beyond the skin of the boats, so that the ram-bow presents no difficulty. This point is only noted in case it should be found expedient hereafter to project the torpedo-tubes.

In all the first boats the screw was abaft the rudder, and Yarrow still adheres to this disposition, although it presents serious service objections, as will be shown. About 1878 Thornycroft shifted the screw to its normal position; shortly afterwards the lower part of the stern-frame was cut completely away, and the screw-shaft was given an inclination such as to bring the hub of the screw on a line with the keel, the lower part of the rudder being hung to an attachment on the hub itself. An interesting series of experiments was carried on by Yarrow in 1879 with regard to the position of the screw. In that year a Herreshoff boat was sent to England to compete with the English boats, and in this boat the screw was entirely underneath, and about $\frac{2}{5}$ aft of the midship section. Greater speed and turning power was claimed for this disposition. The Italian Government directed Yarrow to test the arrangement in a first-class boat, then being built for them. In this boat the screw was first tried in the Herreshoff position, then midway between that and the normal, and finally in the normal position. In all three cases the engines developed 480 indicated horse-power, the speeds being as follows: Herreshoff position, 18.3 knots; midway position, 19.2; normal position, 20.7 knots. Much of this difference Yarrow ascribed, and with reason, to an increase of skin friction in the first two positions caused by filling in the ordinary screw aperture and altering the after-body to allow the screw to go under the bottom. All boats are now built with the screw in the normal position, except Yarrow's, as above stated.

There have been several alterations in the rudder of minor importance, principally due to alterations in position of the screw; in regard to shape, the fish-tail seems to be preferred. In 1878 Thornycroft introduced a patent steam steerer, which is now universally used in first-class boats. In 1879 Yarrow introduced the bow-rudder, which is now universal in the large boats. This rudder is hauled up like a center-board when not in use, and is so connected to both the hand and steam gear of the after rudder that the two can be used together or separately at will. The bow-rudder is considered one of the most important of the improvements as aside from the increased turning-power it gives full control of the boat under sternway.

The plates and frames of the boats were at first simply cleaned and carefully painted, but since 1877 all the material is galvanized.

In the first Norwegian boat, only the fore and after peaks, engine and boiler-room were permanently decked over, the remaining spaces being covered with movable plates. In the next boats, however, and universally since, the decking is complete fore and aft. The Lightning carried a booby aft in order to allow standing erect in the cabin, but since then this arrangement has been suppressed, the constant tendency being to keep everything possible as near the gunwale level as may be. As a rule, the boiler and engine-room sections of the boats are the highest, except, of course, the pilot-house. The German first-class boats even succeeded in carrying a flat deck fore and aft, with a crown only slightly greater than the ordinary deck-rule. Sky-lights are carried by these boats with battle-plates provided underneath.

The first armament, as before stated, was the towing-torpedo, towed from the top of the smoke-pipe in the Norwegian boat and from a permanent staff in the others. The inefficiency of this weapon being soon discovered, it was replaced by the spar torpedo, boats as a rule carrying two spars launching from the bows. About 1877, the spar torpedo gave way to the Whitehead, with which the Lightning was provided. This torpedo was at first (on the Lightning and boats of her class in *England*) discharged from the Whitehead torpedo gun by compressed air acting on a piston against the rear of the torpedo. The gun was mounted in the bow and pivoted so as to give an arc of discharge of about 270°. Two reserve torpedoes were carried on trucks just abaft the gun. By this method a good train was obtained without turning the boat, but it left all the torpedoes up in the air as an element of great danger in case of a torpedo being hit by a projectile, and for this reason the system was never favored outside of England. In all other boats the torpedo is dis

charged from tubes built into the boat and opening near the water-line forward, like immense hawse-holes. The discharge through these tubes is, in the first class boats, by compressed air, as with the gun. Two tubes are carried with two reserve torpedoes, which are carried in the men's quarters amidships and bulkheaded as an additional protection. They are raised by radius-rods to the loading position. In the late and large boats, the discharge tube is doubled in length with a gate in the middle, the reserve torpedoes being carried in the after half, so that the reloading is simplified. In both methods the men are not exposed nor are the torpedoes in reloading. In all cases, the tube is considered to furnish sufficient protection to the torpedo within it. In the second-class boat, all of these methods were found to entail too much weight, and so could not be applied. In 1877 Thornycroft invented a cage hung from davits which worked like monitor davits. The cage was carried amidships so that when lowered the torpedo went just under water, and, laid in a fore and aft line, it was discharged by starting ahead under its own screw. This system was found to be ineffectual, as it necessitated slowing down the boat to a speed of not over three knots. In 1879 Yarrow introduced a system of steam discharge. The forward deck of the boat is shaped into two parallel troughs with covers that hinge and clamp. The torpedoes stow permanently in these troughs, the rear end resting against a piston-head, which is the discharger. The piston itself is simply a hollow tube encased, the small size of the boat and the angle of discharge bringing its position in the boiler-room close to the boiler, so that it is always warmed and ready to develop the full power of the steam. Steam is injected when desired and, after the discharge, is exhausted into the condenser. This apparatus is compact and light. It gives to the bow of the boat a turtle-back deck, which in so small a boat is rather an advantage.

The water-tight division of the Norwegian boat consisted of six compartments, viz. fore-peak, used as a store-room; fore-sheets, open and provided with seats for the crew; pilot-house, covered with $\frac{3}{16}$-inch plate; boiler and engine room in one and covered with $\frac{3}{16}$-inch plates; stern-sheets, open and provided with seats; after-peak, used as a store-room. As the boats increased in size and were improved this compartment division increased until, in the present first-class boats, it is usually as follows: eight full, and 2 or 4 partial compartments (bunkers, &c.). The full compartments are: fore-peak, or collision compartment, unused; forward compartment, used as a store-room; berth deck, for the crew, and also containing the reserve torpedoes; smoke-box room, containing the forward end of the boiler; boiler-room (in the Yarrow boats this compartment is subdivided as will be hereafter explained); engine-room, officer's quarters; after-peak, used as a store-room.

Important modifications have been introduced to provide for draft, safety of firemen, and rapidity of raising steam. Provision is made for exhausting the steam from the boiler, either directly into the condenser or directly into the air. Bilge-pumps and steam-ejectors are provided for clearing the compartments of water, and arrangements are made so that all the pumps may be put at this work, as well as from 2 to 4 hand-pumps. Water entering any of the compartments runs through valves in the bulkheads to a well in the engine-room, although where ejectors are provided the compartments may be emptied independently. In the bilge of the boiler-room the water runs through pipes to prevent carrying dirt to the pumps. In the second-class boats an arrangement is provided for taking steam from a ship's main boiler to aid in getting up steam rapidly. This arrangement consists, in the main, of an injector pipe entering the bottom of the boiler from a valve on deck to which a flexible pipe runs from the ship's main boiler; a branch also runs from this valve to the ventilator engine. The boiler being filled and fires started, the steam is turned on, thus rapidly heating the water in the boiler, and at the same time pushing the fire by giving a draft. Steam may be raised to 60 pounds in about ten minutes.

Thornycroft's invention for preventing a rush of steam or flame into the fire room in case of a leak into the fire box or a back pressure consists in an arrangement of flaps hung at the front of the ash-pit in such a manner that the air-pressure in the air-tight fire-room keeps them open; on a sudden back draft, however, they automatically shut; the furnace door secures with a strong spring catch. To prevent over-pressure in the fire-box from a rush of steam, a connection is made by a pipe from the ash-pit to the deck, closed at that point by a spring valve which lifts under high pressure.

Yarrow's method of providing for this contingency is quite different. In his boats an air-tight bulkhead extends from the front edge of the boiler to the sides of the boat, thus making a separate boiler and fire-room. The ash-pit is entirely closed in front (of the boiler) and is open at the rear directly under the boiler. In the bulkhead, on either side, is a man-hole provided with a flap similar to the Thornycroft one. The pressure in the air-tight fire-room, as before, keeps these flaps open and a sudden back pressure closes them. The great advantage of this system is that it provides for a shot entering the boiler, which the other does not. Thornycroft has coal-bunkers on each side of the boiler. With Yarrow's arrangement this is not done and

the boiler-room necessarily becomes a clear waste space, reducing very materially the coal supply. This was one of the principal faults of the Batum. With both these inventions no proviso is as yet made for the case of an open furnace-door when accident occurs.

Yarrow introduced an arrangement to provide for the case of leak occurring, which endangers the fires by the water rising in the boiler-room. In this the whole fire-box is encased up to the water-line, the draft passing inside the casing, and the furnace-door is made water-tight. The water is thus kept out of the ash-pit and furnace, and time is allowed for feeding a full supply of coal, amounting to nearly half a ton, which is sufficient to run the boat 40 miles. The door is then shut, and thus steam is maintained for running and pumping until clear of danger. Yarrow has also introduced improvements in the details of the furnace, fire-box, and tubes, so as to greatly remedy, if not cure, the liability to leak when sudden changes of temperature give rise to unequal expansions and shrinkages. Arrangements are made for sweeping out the tubes when running. The smoke-box doors are covered with asbestos, and so arranged as to open independently, permitting the firemen to shelter themselves behind one door while sweeping out the tubes of the other half of the boiler. This necessitates a great reduction in the steaming, and the use of the natural draft alone. Steam pressure is lost during the operation.

TORPEDO PINNACES.

The second-class boats are in no way fitted for the general service of a ship, and when carried by a man-of-war must be kept like the rest of the armament for the special service for which they were designed. This has caused some dissatisfaction on the part of naval officers, and in point of fact the scope of the utility of these boats is clearly brought in question in the German Reichstag Report, which intimates that the work of providing the iron-clads with special torpedo-boats has been partially stopped.

Yarrow & Co., to meet this dissatisfaction, have designed a special form of steam-pinnace, intended to be equally well adapted for guard-duty, torpedo work, and general service. The dimensions of this boat are: Length, 54 feet; beam, 9 feet; weight complete, with torpedo armament, 10½ tons; horse-power, 150; speed, 15 knots. The boat is of steel, and has open stern-sheets of the ordinary steam-launch pattern. In the bow a Whitehead launching-tube is fixed, which may be unshipped if desired and replaced by a gun or by freight. The reduction in speed is made up by increased handiness, and from the description it would seem to be a more desirable pattern for ship service than the second-class boat.

THE BATUM.

This boat is 100 feet long, 12 feet 6 inches beam, and has a load draught of 2 feet 8 inches forward and 4 feet aft. The hull is built entirely of steel. The thickness of the bottom plates and the middle strake of the deck plating is about $\frac{5}{32}$ inch (No. 8 wire gauge); the other plating is much thinner. The bottom of the boat is quite flat, there being no keel whatever, in place of which there is a slight rounding.

This arrangement is considered very faulty by Lieutenant Sazaremy, of the Russian Navy, who commanded the Batum on her passage from London to Nickolaieff, on account of the tendency of the boat to roll and to list quickly. He advises the attachment of a keel of about 9 inches depth, together with a slight modification of the bottom lines.

The boat is divided by seven bulkheads into eight water-tight compartments, as follows: Fore-peak, forward compartment, torpedo and berthing room, smoke-box room, boiler and fire room, engine-room, officers' room, and after-peak.

Nothing whatever is stowed in the fore-peak, which is connected with the forward compartment by a manhole.

At sea this compartment was almost always full of water, partly on account of defective riveting of the bottom plates, partly through defective jointing of the torpedo-tube with the bow-plates.

In the forward compartment, the torpedo-magazines were stowed on one side, paint and oil on the other.

In the berthing-room are eight bunks at the sides, in two tiers, the galley, a machinist and carpenter's work-bench, a chest for the clothing of the crew, and a water-closet. This compartment is also the torpedo-room, and carries two torpedoes, the air-pump, and the regulator.

Between the boiler-room and the berthing-room is the smoke-box room, where the fire-tubes are cleaned. In order to do this work, a manhole is cut in the bulkhead.

The boiler and fire room is cut in two by the Yarrow compartment.

Lieutenant Sazaremy states that in all his experience with torpedo-boats he has never seen the necessity of this arrangement, which possesses several objectionable

features. Leaving out of consideration the special idea for which it was introduced, he found that it was impossible to stow any coal in this boiler room, as it would interfere with the draft going to the ash-pit, and so would affect the steaming power. As in the passage from London there never was a necessity for carrying high steam, and so a minimum of coal could be carried, he found it barely possible to stow 3 tons. If it is necessary to provide for the contingencies for which the modification was introduced, Sazaremy considers the Thornycroft system to be sufficient, in which case it is possible to carry 4 tons between the boiler and the side of the boat. No coal stowing place is even provided in the Batum in the fire-room. During the passage it was necessary to carry about 4½ tons in sacks stowed on each side up to the deck-beams, and piled on the fire-room floor to a height of a foot and a half, leaving only sufficient floor space to work the fires and give free space to the draft from the ventilator to the manholes in the bulkhead. As the ventilator was secured to the engine-room bulkhead, quite a wide passage had to be left free. If the ventilator had been put nearer to the forward bulkhead, sufficient room would have been secured to put up permanent bunkers, whereby the disagreeable whirling of coal-dust about the fire-room would have been avoided, and the disagreeable draft which affected the breathing of the men would have been stopped. If such a ventilating arrangement be adopted it can also be made much smaller, as in such a case it would not have to keep the whole fire-room under pressure.

In the engine-room are the main and auxiliary engines, a condenser, a cistern for fresh feed-water, two tanks for oil and tallow, and several other necessary attachments. Over the main engine is a sky-light of oval section, surrounding the cylinders, as the latter rise 1¼ feet above the deck. In the after part of the engine-room is the hatchway and ladder. The different parts of the engine are very compact. The tubes of the condenser may be shifted without moving it from its place.

Sazaremy considers that the sky-light or hatchway should be made larger, as the machinist, when working the engine, does not stand in that space, but under the deck, where he is very much hampered by being obliged to stoop; especially is this an interference in stopping or altering speed. Another objection to this compartment is that no ventilation is provided for it. During the trip from London the temperature in this room rose to 156° Fahrenheit several times. No connection can be made with the fire-room for ventilating, as the great amount of coal dust flying about there would soon interfere with the working of the engines. If Thornycroft's system be adopted, not only can coal bunkers be provided, but the bulkhead may be taken down altogether without sacrificing the buoyancy of the boat. A sill 1½ to 2 feet high might be run across, which would be sufficient to keep water from one compartment entering the other.

In the officer's room are three bunks, a dining table, washstand, wardrobe, clothes chest, and water-closet.

In the after peak are five water-breakers, two chests for provisions, two rope-reels, spare parts of engine-gear, and the fighting-tiller.

Sazaremy suggests that if tanks shaped to the boat's contour be substituted for the breakers, and several of the useless things be removed from this compartment, it would give plenty of room for a ton of coal.

Like all of Yarrow's boats, the Batum has a very large turtle-back forecastle, extending fully one-third of the boat's length. At the rear end of this is the pilot-house. The roof of this house may be raised or lowered by means of screws. Under ordinary circumstances, it stands about 4 inches above the edge of the house, so that even at night a clear view is given all around the horizon. The upper edge of the pilot-house is 6 inches above the center-line of the turtle-back.

Sazaremy considers that it would be well to give the turtle-back still more crown, so as to give better ingress from the rear into the men's quarters. A corresponding increase in height of pilot-house is also considered advisable in order to keep out the spray and sea. The elevated part of the deck should be carried aft to the compartment bulkhead in order to give more head-room on the berth-deck.

In the pilot-house is the fighting-wheel, which can be used on both after and forward rudders. There is abundance of room on the platform for both the helmsman and commander. On the platform is a telegraph and speaking-tube for the engine-room and the valve for firing the torpedoes.

Under ordinary circumstances, the bow rudder is kept hauled up in its well, and the steering is done by the hand-wheel on deck. If, however, it is necessary to use the bow rudder the steam fighting-wheel must be used, as the coupling is to that arrangement.

Water-clearing is provided for by six ejectors, one in each compartment except the peaks.

The ventilation of the berth-deck is accomplished by a small ventilator in the pilot-house roof and by two pipes just under the deck, one end of the pipes being in the berth-deck and the other in the smoke-box room. The draft thus furnished by the difference in temperature exhausts the foul air from the berth-deck.

On deck forward are two cranes for shipping the torpedoes.

Sazaremy considers the cranes too weak, and a tackle insufficient for the heavy work for which a little steam windlass should be provided.

The boat carries one anchor of 200 pounds weight and 600 pounds of ½-inch chain.

Sazaremy considers this sufficient for the trip of the Batum, as the anchor always held well and the chain never broke. In general, however, he considers it better to have two anchors and chains. He also considers it better to have a windlass for getting up anchor, as it always required all hands to get it in in getting underway.

The boat carried a Thompson compass, which Sazaremy considers should be replaced by a liquid one, as the short rolls of the boat frequently would spin the card around.

The Batum carries a light pair-oared yawl, 10 feet long, 3½ feet wide, and weighing 140 pounds. It is built of cedar, and has two air-chambers. It can carry six persons and when filled with water will support four. This boat suffices for the service of Batum.

The main engines consist of a two-cylinder compound direct-acting engine. Diameters of cylinders, 12½ and 21 inches; stroke, 17$\frac{11}{16}$ inches; indicated horse-power, The condenser is fore and aft on the port side, and the fresh-water tank on the board. By this fore-and-aft arrangement the tubes may be changed without moving the condenser, but in order to do it the greater part of the arrangements in the cers' quarters on the port side must be removed, in order to get at the manhole in bulkhead and do the work.

Sazaremy thinks this arrangement a very faulty one, as, when the condenser is full, the boat has a list to port and her speed is affected. He recommends putting the condenser in the forward part of the officers' quarters athwartships, with the feed-p at one end of it, there being plenty of room for this arrangement; then by put the fresh-water tank athwartships in the forward part of the engine-room so much room would be gained in this compartment as to allow of the extension of the coal bunker space so as to give the boat a supply of from 10 to 12 tons.

The piston-rods are hollow; the upper ends of the cylinders are braced from skylight frames, and in this manner the jar of the engine is quite prevented. Al... frames in the shaft-alley are utilized as thrust-bearings. The auxiliary engine work the circulating-pump, feed-pump, air-pump, and, in case of necessity, the bilge-pump. The injection-opening has two Kingston valves, through one of which water goes to the feed-pump and through the second to the condenser.

This opening should be nearer the bottom, as it rolls out of water in a seaway, and so affects the vacuum.

In case the auxiliary or the condenser breaks down, arrangements are made for working under high pressure alone. The screw is about one foot abaft the rudder.

The screw is neither protected in rear nor underneath. The slightest contact aft with anything, ground, collision, &c., is sufficient to either bend or break off the thin blades. Sazaremy states as his experience that this touching aft is a matter of very common occurrence in torpedo-boats, and considers that the most careful commander cannot avoid it in peace times, let alone war, where barricades, nets, &c., have to be contended with. The experiments of the French with regard to speed and tur power with the screw before and abaft the rudder have proved that the speed is ... in the slightest affected by having the screw forward; so that even if it were sacrifice of a half a knot, Sazaremy considers that the protection of the screw de... that it should go as in Thornycroft's boats.

The boiler is of the locomotive type, cylindrical and steel; length 15 feet ... inches: diameter, 4 feet 4 inches, and contains 686 gallons. The fire-box is copper; the grate-bars, 96 in number, are 2 feet long. Heating surface 400 square feet; grate surface, 29.3 square feet. The boiler was tested to 260 pounds, the normal pressure being 130 pounds. There are 176 fire-tubes of brass, 9 feet 3¾ inches long by 1¾ inches outside diameter.

The tubes are too small, as they become very much clogged with soot in a very short time, even when using the best coal. They have to be cleaned about once in 7 or 8 hours, and during the operation the steam falls and the effectiveness of the boat is sacrificed.

The boiler is fed by a feed-pump and an injector; a hand-pump is also provided, and there is an opening in the top of the boiler so that it may be filled from deck.

On torpedo boats a fresh-water feed is necessary. On the Batum, the tank only held sufficient for 4 hours' steaming at moderate speed. This quantity should be increased. On the trip from London Sazaremy always started with boiler and tank filled with fresh water, and then by taking a moderate quantity of salt water, he was enabled to get along without fouling the boiler.

The boiler is provided with one manhole and nine handholes for cleaning it. These holes are quite insufficient for the purpose, as all parts of the boiler cannot be reached. A manhole large enough to admit a boy should be made.

The boiler has two chimneys, symmetrical, situated athwartships. These chi... were originally 5 feet high, but in Fiume the height was increased to 7½ feet, an...

shipped a great deal of water. With a forced draft, great quantities of ashes are rown from the chimneys, so that in a very short time everything gets covered with oot. This does not happen with a natural draft.

The Batum carries four torpedoes; two in the launching tubes and the other two in troughs built for them on deck.

Much trouble was experienced with the torpedo arrangements which were put on board by Whitehead at Fiume. The torpedoes in the troughs have to be put by hand into the launching-tubes, which is extremely difficult work for the few men available. The air accumulators leak badly from the vibrations of the boat acting on the valves, and once empty they cannot be recharged under speed, owing to the vibrations and other defects. The torpedo in the tube is only held fast at the rear end of two stoppers, leaving the other nine-tenths of it loose in the tube, so that the vibrations of the boat injure it. In a run from Nickolaieff to Odessa with the torpedo in place, the following damage was done: The rudder part of both torpedoes was bent somewhat sidewise. The screws which fasten this part to the end piece had slacked up. T rudder-head of one of the torpedoes was doubled up. In one torpedo the screws necting the engine section with the air-chamber were slacked up. The pendulum d hammered into the wooden bulkhead about ⅛ inch. This damage was done by a king up of three hours. Sazaremy considers that the mouths of the tubes ought be made to take the contour of the boat's bow, as it will make no difference in the m of the torpedo under any circumstances. Although the mouths of the tubes are osed by stoppers they are not perfectly water-tight, and a good deal of water en- rs which finds its way into the regulator, and often into the tube between the reg- tor and accumulator. In a trial made it was found that the torpedo could not be ched on this account. This trouble is serious, since before the torpedo can be d the mouths of the tubes must be opened, and thus a quantity of water is allowed rush in. That these difficulties have not been discovered before is due to the fact at heretofore experiments have been carried on in still water and at low speeds. aremy insists that all experiments with sea-going boats should be carried on at

The itinerary of the trip of the Batum to Russia is as follows:

Ports.	Miles.	Hours.
don to Brest	470	43
st to Ferrol	340	46
rol to Lisbon	340	36
on to Gibraltar	300	27
ltar to Algiers	430	36
s to Bona	245	22
to Messina	450	33
ina to Brindisi	270	24
disi to Fiume	360	....
me to Gravosa	270	24
rosa to Zante	330	....
te to Syra	270	....
a to Constantinople	330	....
stantinople to Nickolaieff	430	....

Mean speed for the whole trip of 4,835 miles, 11.1 knots.

During this trip the boat experienced all sorts of weather, steaming against a full gale in the Bay of Biscay. Only once was she obliged to stop *en route* to cool a bearing. She was tested under sail alone, and found to work thoroughly well. The small supply of coal was all that prevented a much faster record.

According to the contract, the trials previous to delivery in London were to be made with the boat light, and it was made with the least weight possible aboard. Indeed, so little coal was carried that the boat had scarcely enough to bring her back from the measured mile. Under these circumstances, she obtained a mean speed of 22.16 knots for six runs over the measured mile, carrying a pressure of 130 pounds. Experiments were made to establish the flotation elements of the boat with the following results:

Fully laden, at a displacement of 48.2 tons the metacentric height was 2.1 feet.

At the load-line the boat required 1.8 tons for an inch of immersion.

At the load-line the center of gravity was 3 feet 6 inches from bottom of keel or near water-line.

At 45 tons displacement, center of gravity was 3 feet 1½ inches from bottom of keel.

The maximum stability was reached at a heel of 50°. Lever arm, 1.35 feet.

At 10° heel the gunwale was at the water-level.

The Batum was given a trial at Nickolaieff, with full outfit aboard. Under these conditions, with 115 pounds' steam, 332 turns of the screw, she made 15¼ knots over the

measured mile. Much of this great fall in speed was attributed to poor coal and ba firing. In a trial run from Nickolaieff to Odessa and back, a distance of 15[illegible] with a fresh breeze, the mean speed was 13.7 knots.

In closing his report Sazaremy sums up the faults of the Batum: (1) Too l[illegible] coal supply, only sufficient for 350 miles; (2) too low speed when fully equipped. [illegible] recommends for future boats—

(1) A length of from 100 to 120 feet to allow heavier machinery and more coal.
(2) A beam of 13½ to 14 feet.
(3) Better shaped upper works.
(4) Simpler and lighter torpedo apparatus.
(5) A larger boiler, with two furnaces and a more powerful engine.
(6) To be more solidly built; the bottom plates one-fourth inch and the other eighth inch.

Finally, the contract should stipulate for trials at the deep-load line, the engin[illegible] not to be overworked on the trial, and a mean speed of 18 knots to be maintaine[illegible] four hours. Runs of 20 miles should not be allowed, as they are deceptive.

THE SUCHUM.

This boat, built by Thornycroft, is one of four of an enlarged type of Batum, tw[illegible] of which were ordered from English and two from French firms. The dimensions [illegible] the boat are: Length, 113 feet; beam, 12 feet 6 inches; depth of hold, 6 feet 6 inches; draught, 2 feet 6 inches forward and 6 feet aft; displacement, 60 tons; diameters [illegible] cylinders, 14½ and 24½ inches; length of stroke, 15 inches; heating surface, 1,119 squar[illegible] feet; grate surface, 30 square feet; indicated horse-power, 750.

Many of the improvements suggested by Lieutenant Sazaremy have been intro duced in this boat, which otherwise is quite the same as the Batum, except that sh[illegible] carries two Hotchkiss 37 millimeter revolvers, one on each side at the rail just abaf[illegible] the pilot-house. The first trial trip of this boat took place July 10, 1883, and had fo[illegible] its object to ascertain the maximum speed of the boat when carrying a full outfi[illegible] weighing 6 tons and coal enough to steam 1,000 miles, at a speed of not less than 1[illegible] knots.

The weights carried were as follows:

	Pounds
Torpedo launching gear	5,1[illegible]
Four Whitehead torpedoes	3,[illegible]
Torpedo air-pump	[illegible]
Two Hotchkiss guns	715
One hundred Hotchkiss projectiles	[illegible]
Anchor gear and windlass	
Boat	[illegible]
Complement of sixteen persons	2,[illegible]
Drinking water	
Total	13,[illegible]

To this must be added 10 tons of coal, making a total of 16 tons. The displacement of the boat with this load was 59¼ tons; draught, 2 feet and 5 feet 10 inches. At these lines she made a mean of six runs over the measured mile of 19.49 knots, and a mean of three hours' run of 18.96 knots. The engines worked well; the mean revolutions on the measured mile was 414.75, and during the three hours 403.88. The maximum indicated horse-power was 720. Coal used was 1 ton per hour for 18.9 knots. Steam pressure, 130 pounds per square inch.

The second trial had for its object to ascertain if the coal was sufficient to steam 1,000 miles at a speed of not less than 10 knots. The boat was brought to the same lines as before, carrying 9 tons of coal in the bunkers and 1 ton in bags. The run lasted from 10.46 a. m. to 8 p. m., during which she made 101.11 sea miles, at a mean speed of 10.83 knots, and a total coal consumption of 1 ton short. Steam pressure, 110 to 118 pounds; revolutions, 222 to 227. The requirement of fresh water was a great drawback, as the boat's regular supply was only sufficient for 50 sea miles. Extra fresh-water tanks were carried during the trial, the total amount required being 111.32 cubic feet.

The boat was then submitted to a series of turning trials, with the following results at a speed of 18 knots:

Both rudders: Time to port, 1 minute 20 seconds; diameter of circle, 588 feet.
Both rudders: Time to starboard, 1 minute 35 seconds; diameter of circle, 840 feet.
One rudder: Time to port, 1 minute 56 seconds; diameter of circle, 663 feet.
One rudder: Time to starboard, 2 minutes 50 seconds; diameter of circle, 964 feet.

The boat was then given several trials, with an addition of weights of 5.2 tons, representing the material necessary for a long trip, as follows:

	Pounds.
Boiler covering	1,233
Six boxes Hotchkiss shell	329
Boat and gear	165
Masts and sails	798
Flag chest	51
Chart table	66
Side curtains of sail cloth	71
Spare anchor	199
Drinking water	848
Two spare fresh water tanks and pipes	120
Reserve fresh water for boiler	998
Fresh food, three days	199
Sea stores for eight days	479
Baggage of crew	658
Baggage of officers	399
Navigating instruments and charts	299
Lanterns, flags, stationery, &c	199
Boatswain's stores	686
Engineer's stores	2,860
Oil and tallow	419
Small articles undetailed	299

With the entire load the displacement of the boat was 64 tons, and with this she made a mean speed of six runs of 17.93 knots, with 404.3 turns and 130 pounds of steam.

By test it was found that she would steam 252 knots at a speed of 15.45 knots; 372 knots at a speed of 23.39 knots; 189 knots at 18.9 knots, and 1,000 knots at 10.8 knots.

A test was made of cleaning the fire tubes while running. For this the whole forward part of the smoke-box doors and the smoke-box itself is covered with asbestos, and the doors are arranged to open independently. The man cleaning the tubes shelters himself behind the closed half of the box. In the test the steam was allowed to fall to 40 pounds, and the engine was slowed to 100 turns; 35 tubes were cleaned in a quarter of an hour; the temperature in the compartment, which, at the commencement, was 113° Fahrenheit, sank during the work to 88°, and the steam fell to 30 pounds. No trouble was experienced with the gas, as there was a perceptible draft from the berth-deck, through the manhole in the bulkhead, and into the smoke-box.

The boat made a very successful passage from London to Nickolaieff. The side-curtains were found to be very useful in keeping water from slopping into the engine-room. In a heavy cross-sea the seas often swept over the roof of the pilot-house, but in a regular sea she was very buoyant.

At Nickolaieff she was given another trial, when, over a 2-mile course, the highest mean speed that could be reached was 16.21 knots. This was attributed to poor coal and inefficient firing.

The Hotchkiss guns were tried at sea, and found to work efficiently, there being no recoil effects whatever noticeable.

THE CHILDERS.

This boat, built by Thornycroft for the Australian Government, is slightly smaller than the Suchum. Her dimensions are: Length, 112 feet 10 inches; beam, 12 feet 6 inches; draught aft, 6 feet; displacement, 58¼ tons; diameters of cylinders, 14 and 24¼ inches; stroke, 15 inches; heating surface, 1,119 square feet; grate surface, 30 square feet. She carries four Whitehead torpedoes and two Hotchkiss guns, 37 millimeters.

On her official trial the maximum speed reached was a little over 19 knots. During a three hours' trial with an outfit of 14½ tons she reached a mean speed of 18¾ knots. During this trial it was ascertained that at a speed of 11½ knots she burned 203 pounds of coal per hour. The supply of the boat being 10 tons, is enough to carry her 1,270 knots at this speed.

THE LATEST GERMAN BOAT.

The Berliner Zeitung of July 10 contains the following telegram from Pillau: "Day before yesterday the first of the new boats building at Schichau was tested at this place. With complete outfit and stores and coal for steaming 1,000 miles she attained a maximum speed of 20½ knots. On the last run the rudder was twisted by being put over too quick, and the trial was stopped. Yesterday it was resumed and this time a run was made from Pillau to Neufahrwasser and return, a distance of between 50 and 60 miles.

The run over was made in 2¼ hours and back in 2¼ hours. Maximum speed attained, 21¼ knots. Indicated horse-power, 1,000. This is the highest speed for prolonged running yet attained by a torpedo-boat."

BEHAVIOR OF FRENCH TORPEDO-BOATS AT SEA.

In April last the evolutionary squadron left Toulon for the eastward in the teeth of an easterly gale, the iron-clads being accompanied by two torpedo-boats. The squadron consisted of the Richelieu, Marengo, Trident, Duperré, Redoutable, Vengeur, and Tonnerre, with the dispatch-boats Hirondelle and Renard, and torpedo-boats Nos. 64 and 65.

The dimensions of these boats are: Length, 108 feet; beam, 10 feet 10 inches; draught, 2 feet 10 inches; displacement, 46 tons. They carry a coal supply sufficient for 600 miles at a speed of 12 knots.

Arrived off Hyéres the two monitor vessels Tonnerre and Vengeur had to run in to an anchorage, being unable to keep their stations on account of the sea. The admiral had reduced the speed of the squadron from 10 knots to 8, and then to 6. It was found impossible to reduce the speed of the torpedo-boats below 8 knots, so they kept that speed until some distance ahead, and then stopped and dropped back to their stations. No difficulty whatever was found in navigating the boats in the heavy sea. Head to it, they rose to the sea with great buoyancy, and all the deck abaft the pilot-house was clear of water and could be used as a promenade with safety. Broadside to the sea the rolling was heavy, but not so much as to hamper the movements. No trouble whatever was experienced with the screw, as it was out of water so short a time that there was no racing of any consequence. The men's quarters were, however, very uncomfortable. It was impossible to use the galley, and the vibrations were so great as to cause seasickness. Both boats were somewhat troubled with leaky rivets. Steering with both rudders and with the after one alone was tried and the boats in all cases answered the helm with the greatest readiness.

THE FRENCH SYSTEM OF NUMBERING BOATS.

In the French service second-class boats are numbered consecutively up to 60. All above that number are first-class boats. No. 65 was launched in June, 1884.

THE SCOPE OF GERMAN NAVAL COAST DEFENSE SUPERINTENDENCE.

MARCH, 1884.

"It is the expressed will of His Majesty the Emperor, with regard to the coast defense, that hereafter the navy is to be intrusted not only with the defense of the two great dock-yards, but also with the maritime defense of Prussian fortresses on the coast and seaports. It is considered that for a thorough defense the army and the navy should work together according to clearly laid down rules, and to the navy should be given the supreme control of all maritime operations. From this time forward all harbor entrances must be in a condition to be immediately protected by mines and troops. Heretofore all this work having been intrusted to the army, the engineers during the operation of mobilization were overburdened. In the future, however, the navy, through its interest and technical skill, can readily keep harbors and channels open for the passage of friendly vessels up to the last moment and close them quickly and certainly when necessary. Again, the introduction of torpedoes proper into the cadre of army weapons reduces the general efficiency of the service, as has been shown in operations with mines. The army commandant of a coast place would find it difficult to properly control the naval *personnel* which in any case is necessary for the service, and he could but illy superintend the movements of torpedo flotillas. Finally, in order to establish communications with the naval outposts, extra steamers under army control would be necessary, which would complicate the service. Requisitions for merchant vessels and materials could not be wisely filled under army superintendence, and a harbor once blocked by mines, all movements, no matter how urgent, of naval vessels, could only be undertaken after arriving at a special understanding between the army and the navy."

19.—REPORT OF GUN FOUNDRY BOARD.

Message from the President of the United States, transmitting a report of the Board of Army and Navy Officers relative to the best location for establishing a Government foundry.

FEBRUARY 20, 1884.—Referred to the Committee on Appropriations and ordered to be printed.

To the Senate and House of Representatives:

I transmit herewith to the House of Representatives the report of a Board of Army and Navy Officers, appointed by me in accordance with the act of Congress approved March 3, 1883—

For the purpose of examining and reporting to Congress which of the navy-yards or arsenals owned by the Government has the best location and is best adapted for the establishment of a Government foundry, or what other method, if any, should be adopted for the manufacture of heavy ordnance adapted to modern warfare, for the use of the Army and Navy of the United States; the cost of all buildings, tools, and implements necessary to be used in the manufacture thereof, including the cost of a steam-hammer or apparatus of sufficient size for the manufacture of the heaviest guns.

CHESTER A. ARTHUR.

EXECUTIVE MANSION,
February 18, 1884.

GUN FOUNDRY BOARD,
1727 *Pine street, Philadelphia, Pa., February* 16, 1884.

To the President:

In accordance with your instructions of April 2, 1883, issued under the provision of section 1 of the "Act making appropriations for the naval service for the fiscal year ending June 30, 1884, and for other purposes," approved March 3, 1883, the Board, composed of six officers selected from the Army and Navy, "for the purpose of examining and reporting to Congress which of the navy-yards or arsenals owned by the Government has the best location and is best adapted for the establishment of a Government foundry, or what other method, if any, should be adopted for the manufacture of heavy ordnance adapted to modern warfare, for the use of the Army and Navy of the United States; the cost of all buildings, tools, and implements necessary to be used in the manufacture thereof, including the cost of a steam-hammer or apparatus of sufficient size for the manufacture of the heaviest guns," has the honor to submit herewith its report and the record of its proceedings.

In order to reply satisfactorily to the act of Congress, it was necessary for the Board to seek information in Europe, and visits were made to England, France, and Russia. It is appropriate to state that your Board was received by both Government officials and by private companies with much cordiality, and every assistance was rendered in its nvestigations in those countries.

It was the desire of the Board also to visit the large German s eel works at Essen, but the permission to do so, which was requested of Mr. Fried. Krupp, was not granted for reasons that will be found stated in the copy of correspondence attached to this report.

The Board, having completed its duties, have adjourned *sine die.*

Very respectfully, for the Board,

E. SIMPSON,
Rear-Admiral, United States Navy, President of the Board.

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APPENDICES.

REPORT OF THE GUN FOUNDRY BOARD.

The act of Congress, approved March 3, 1883, under which the Gun Foundry Board was organized, calls for a report on the following points:

1st. Which of the navy-yards or arsenals owned by the Government has the best location, and is best adapted for the establishment of a Government foundry.

2d. What other method, if any, should be adopted for the manufacture of heavy ordnance adapted to modern warfare, for the use of the Army and Navy of the United States.

3d. The cost of all buildings, tools, and implements necessary to be used in the manufacture thereof, including the cost of a steam-hammer or apparatus of sufficient size for the manufacture of the heaviest guns.

The first question presupposes the establishment of a Government Gun Foundry, properly so-called, the establishment to be under the absolute control of the Government, and the details of all work to be supervised and directed by Government officers.

The answer to this question involves simply an expression of opinion as to the superior adaptability, for the purposes of a gun foundry, of any navy-yard or arsenal now owned by the Government.

The second question imposes no limitation, and calls upon the Board to suggest "any other method" (apart from a Government foundry, pure and simple) by which the purposes of the act of Congress can be achieved. The Board is evidently called upon to consider the subject of joint action between the Government and private parties for the accomplishment of a national purpose.

The Board decided that there were three points of view from which this subject should be considered, viz:

1st. That the Government should supplement the plants of some of the steel workers of the country with such additional tools and implements as would enable them to turn out finished steel cannon.

2d. That the Government should give contracts of sufficient magnitude to enable the steel workers of the country to supply the finished guns without its direct aid.

3d. That the Government should establish on its own territory a plant for the fabrication of cannon, and should contract with private parties to such amounts as would enable them to supply from the private industries of the country the forged and tempered material.

The course of the investigation being thus indicated, the Board addressed circular letters to several of the steel manufacturers in the country and to the two companies employed in the fabrication of cannon. These letters and the replies thereto will be found in the correspondence attached to the record of proceedings of the Board, and copies are appended to this report. The replies were unsatisfactory, the subject being a new one to the parties addressed. The expense to be incurred could not be calculated upon any known basis, and the

Board was unable to satisfy the calls mad upon it for further information as to the number of guns required or the probable extent and cost of a plant for the manufacture of such heavy guns as the act of Congress contemplated.

It was evident that none of the desired information could be obt d from our manufacturers, because of their lack of experience on t subject. It was known, too, that several of the European Governi had had more or less experience of joint action with private establishments. The call by the act of Congress for "the c o buildings, tools and implements for the manufacture of the n guns" could only be answered by information and experience o d from abroad, as no such tools or implements have been manu tured or are in use in the United States. The steam-hammer menti the act was recognized as a subject requiring careful consideration. is coupled with a qualification, "or apparatus of sufficient size," which indicates that there existed a doubt as to the propriety of the use of a steam-hammer for forging if other "apparatus of sufficient size" could be made more efficient. The advances made of late years in the process of forging by compression made this a very important matter for consideration. This subject is necessarily connected with that of the manufacture of the metal to be forged, and involves a study of the recent developments in steel. The actual condition of the armaments abroad, so far as it illustrates the latest ideas, was felt by the Board to be an important part of the information on which it should report, as the character of the new constructions of cannon would necessarily control that of the tools to be recommended for use in their fabrication.

The foregoing reasons governed the Board in its decision to represent the necessity of seeking information abroad. Orders were issued and the Board proceeded to Europe. The first visit was made to England.

ENGLAND.

SOURCES FROM WHICH THE ARMAMENT OF ENGLAND IS SUPPLIED.

Previous to the year 1859 the Royal Arsenal of Woolwich was the only source from which the armament of England was supplied. The arsenal was a purely governmental establishment, in which there were several departments. The department of the Royal Gun Factories was always under the command of an officer of the Royal Artillery; and here all cannon for the army and navy were fabricated.

Since the year 1859, the Elswick Works at Newcastle-on-Tyne has been a source of supply on which the Government has drawn more or less for guns. The experience of the connection of the English Government with these private works bears directly upon the subject of joint action between a Government and a private firm.

This connection dates from the time when attention was called to the improvements in rifled ordnance inaugurated by Mr. William G. Armstrong.

The Armstrong gun was first brought to the notice of the Government in 1854, and in July, 1855, a 3-pounder was delivered, with a report of the experiments that had been made with it. The gun was re-bored up to a 5-pounder, and in December, 1856, was tried; the report stated that good practice was obtained at 1,500 and 2,000 yards. In January, 1857, a second gun was ordered. It was an 18-pounder, and was tried in January, 1858. The report was favorable, and the gun was so far

approved as to cause the recommendation that two should be issued to the artillery to "knock-about, and be reported on as to their endurance of work in comparison with the service guns."

In 1858 there arose a pressure for a supply of rifled field guns for the y, and a committee, after investigation, reported that it was expe- it to experiment only with the Armstrong and Whitworth guns.

There has always been a controversy as to the manner in which the rison between these two guns was made. But the result of the ai was the adoption of the Armstrong system for field service, which this time involved the following combination of construction, viz: ech-loading, rifling, and coating the projectile with soft metal.

In order to obtain as soon as possible a supply of these guns, it was de- d to supplement the resources of Woolwich by entering into arrange- s with a company set up at Elswick for the manufacture of the guns ojectiles. A guarantee was given to this company on the 16th January, 1859, to secure them against loss by the erection of build- 's and machinery. The Government undertook to keep them in full rk, but reserved the right to terminate the engagement on the pay- of compensation. The necessities of the service requiring a larger aoer of these guns to be provided than was at first anticipated, the ginal guarantee was increased first to £50,000, and then to £60,000. October, 1859, owing to increased pressure for guns, the guarantee raised to its final amount of £85,000.

Sir William Armstrong was, on the 22d of February, 1859, appointed engineer of rifled ordnance, and on the 4th of November, 1859, he be- ne also the superintendent of the Royal Gun Factories, which office he ld until February, 1862. This was the first time that office had been d by a civilian.

September, 1859, the 40-pounder Armstrong gun was approved for navy. Proposals were also approved for the construction of a 110- nder gun, and one hundred of these guns were constructed before y periments with them had been concluded.

The Government was thoroughly committed to the Armstrong system, and the manufacture was carried out at Woolwich by the Government, and at Elswick by a private company.

The large expenditures having attracted attention, a committee was appointed in 1862 to inquire into them, and in April, 1863, the agreement with the Elswick Company was terminated by the Government, which discontinued all orders to it and concentrated its work at Woolwich. The guarantee of £85,000 was paid, the Government, however, being credited with the value of plant and stores, estimated at £19,000, making the amount in money paid £65,534 4*s*.

The committee reported that during the continuance of the agreement with the Elswick Company the following sums had been paid:

(1.) The sum of £965,117 9*s*. 7*d*. for articles supplied.

(2.) After giving credit for the value of plant and stores received from the company, a sum of £65,534 4*s*., as compensation for terminating the contract.

(3.) The outstanding liabilities of the War Office to the Elswick Ordnance Company, for articles ordered, amounted on the 7th of May, 1862, to the sum £37,143 2*s*. 10*d*.

The whole of these payments and liabilities amounts to the sum of £1,067,794 16*s*. 5*d*.

During the same period there had been expended in the three manufacturing departments at Woolwich on the Armstrong guns, ammuni-

tion and carriages, the sum of £1,471,753 1*s.* 3*d.*, making altogether a grand total of £2,539,547 17*s.* 8*d.*

A statement prepared by one of the assistant accountants-ge the War Office shows the cost of certain guns and projectiles obta from the Elswick Ordnance Company compared with the rates of tl produced at the Royal Arsenal at Woolwich. According to this s ment, taking the class of stores which have been supplied from wick and from Woolwich, and which therefore admit of a direct c parison, the sum of £242,173 10*s.* 6*d.*, on an expenditure of £593,275 11*d.*, would have been saved to the public had these guns, project and fuzes, supplied by the Elswick Ordnance Company, been ma factured in the Royal Arsenal.

The evidence on this subject is acknowledged to be somewhat c flicting. Colonel Boxer, who was the superintendent of the Ro Laboratory at Woolwich, and the accountant-general of the War Office state their belief that the statement is substantially correct, while Mr. Rendel and Captain Noble, R. A., partners in the Elswick Company, object to the basis on which the prices at the Royal Arsenal were ascertained; but there seems no doubt a saving would have been effected if all the articles had been manufactured at the Royal Arsenal.

The above is a statement of facts which exhibits the experience of the English Government in its experiment of joint action with a private company. The plant put up by the Government became the property of the private company at a nominal valuation, and the Government paid about £65,000 to break the agreement, besides paying an increased price on articles manufactured for it.

Elswick.—The subsequent history of the Elswick Ordnance Company under the control of Sir William Armstrong is well known. The plant for the manufacture of cannon has been kept employed by orders from foreign Governments, and during late years much work has been done for the English Government. The enterprise and ability in its management has been of great assistance to the country, and, at the recent readoption of the breech loading system, the Government found Elswick prepared to assist in advancing the manufacture.

Thus, though there seems to have been no profit to the Government in working jointly with the Elswick Company, much aid has been derived from it as an independent assistant, and it may be said that it is the only one which supplements the royal factories in finishing guns.

The establishment at Elswick is thoroughly equipped for heavy work and has produced the largest guns in the world. The shops are supplied with an abundance of fine tools, and the forge arrangements have been, up to the present time, all that was required for the manufacture of the guns heretofore turned out. But a change is being made in some of the details to better accord with the demand for steel cannon, and steel works are being erected capable of casting 100-ton ingots. Blast furnaces are also in operation.

The fact that the Government has abandoned the wrought-iron gun impairs the usefulness of the broad tup-hammer with which the wrought-iron coils were welded, and this is being modified to be more effective for forging steel ingots and hoops. The advantages of the Whitworth manufacture are also recognized and a forging press is being introduced.

The use made of hydraulic power is probably greater at Elswick than at any other establishment in the world. This might naturally be expected, when it is borne in mind that the world is indebted to Sir William Armstrong for the advance made in this direction.

The system of hydraulics at Elswick extends to all parts of the grounds, reaching all the shops, wharves, and water front. Pumping-engines are established at convenient intervals, only one working at a time, and the connection of pipes being continuous, the uniform working of the system is established by five or six accumulators with 18-inch rams. The working of the pumping-engine is made automatic. The accumulator nearest to it is slightly more heavily loaded than the others to give a lead in rising to the distant one, and is connected with a steam regulating valve to act as a governor for adjusting the speed of the engine to the varying demand of the hydraulic machines.

The pressure sustained throughout the system is 750 pounds to the square inch. The pipes are usually 5 inches in diameter, the largest being 6 inches.

Hydraulic power is used for the forge and foundry cranes, also for the movable cranes which operate along the water-front. For the accommodation of these last, pipes are run, in junction with the pressure main, with hydrants from 18 to 36 feet apart, from which connection is made with the cranes by means of telescopic tubes. Two or more cranes can thus be brought into operation on any vessel at the water front.

On the east end of the wharf are erected large hydraulic shears, worked by a direct-acting hydraulic cylinder, 40-feet stroke, lifting 120 tons. The back leg moves so as to bring the lifting cylinder about 30 feet out; the foot is moved by a screw 50 feet long, with hydraulic engine and gear.

The most notable hydraulic crane that has been produced from these works is the one erected in the Italian naval arsenal at Spezzia, which is capable of lifting 160 tons through a range of 40 feet. It is carried on a ring of line rollers supported by a pedestal of masonry, and the slewing is effected by an hydraulic engine applied to a pinion which gears with a circular rack. The rake of the jib or projection from the center of rotation is 65 feet, and its height from the quay-level is 105 feet. The crane is counterbalanced on the side opposite to the load.

About the grounds at Elswick, particularly at the approaches to the shops, there are numerous small capstans worked by hydraulic engines, which are of great service in hauling heavy loads into or out of shops, and in transporting them from shop to shop.

It is almost unnecessary to add that it is at Elswick that the applications for working heavy guns by hydraulic power have been designed and manufactured.

No foundry or gun factory can be considered efficiently equipped without being provided with arrangements for the plentiful supply of hydraulic power.

Woolwich.—The Royal Gun Factories at Woolwich are of very extensive proportions, and have, in the course of many years, become so well equipped that the present change which has been inaugurated in the system of manufacture of the English gun does not find it unprepared. In a Parliamentary report of 1878–'79 a balance sheet states the value of all the property and material in the three departments at Woolwich, as follows, viz:

	£	*s.*	*d.*
Land	2,805	9	4
Buildings	97,684	7	11
Machinery	166,110	11	3¼
To one year's interest, at 3¼ per cent. on invested capital, viz, stores and semi-manufactured articles in stock, April 1, 1878	196,949	15	3
Total	463,550	3	9¼

The capacity for production in the gun factory is stated in 1873–'74 to have been 6,000 tons of guns of various calibers per year, or 7,500 tons of rough forgoings (wrought iron).

An approximation to the number of tools may be reached by citing the number of boring-machines now in place, viz:

2 of 72 inches swing,	4 of 51 inches swing,	4 of 42 inches swing,
4 of 36 inches swing,	6 of 30 inches swing,	6 of 24 inches swing,
12 of 20 inches swing,		

besides 50 or 60 others of various smaller sizes.

Of other machines there are—

6 planing-machines,	12 shaping-machines,	12 milling-machines.
12 drilling-machines,	12 slotting-machines,	6 radial-machines.
2 dividing-machines,		

Of traveling cranes there are—

4 of 60 tons capacity,	6 of 30 tons capacity,	6 of 25 tons capcity,

besides several of from 20 to 9 tons capacity.

The steam-hammers are comprised in the following list:

1 of 40 tons,	1 of 12 tons,	1 of 10 tons,	2 of 7 tons,	2 of 6 tons,

besides many of from 3 to 1 ton.

The steam power in the Royal Gun Factories is supplied by 40 boilers of 40 horse-power each. The uniform capacity of boilers is found convenient in case of repairs, when substitutions have to be made. At one point there are assembled 24 boilers in one group.

The new feature about the gun factories at Woolwich is the establishment of a foundry for casting steel. The development of this branch of the manufacture is still in its infancy, but already there are several Price's retort furnaces in operation, having a total capacity of about 18 tons. The tests of the metal have proved to be very satisfactory, and already some tubes have been accepted for the manufacture of 6-inch steel guns. It is expected, in a very short time, that tubes for 8-inch guns will be produced from this foundry.

The 40-ton steam-hammer, which has been used for welding the large coils of wrought iron used in the late manufacture of the Woolwich gun, is undergoing a change, by having the face of the tup reduced in area in order to be made more efficacious in forging steel ingots. Opportunity is also being taken to reconstruct and repair a portion of the foundation and the anvil block in order to suit the new conditions. In this connection it may be well to state the cost of this hammer, including that of the four cranes used in connection with it, furnished by Nasmyth, Wilson & Co.:

Hammer	£4,960
Cranes and framing	13,500
Expended in department	10,915
Inspector of works, charges for building foundations, furnaces, &c	9,245
Floor plates	3,663
	42,323

Steel Manufacturers.—While considering the sources from which the armament of England is supplied, the steel manufacturers who provide the tubes, jackets, and hoops should be named. They are:

Thomas Firth & Sons, Sheffield.

Charles Cammell & Co., Sheffield.

Vickers, Sons & Co., Sheffield.

Sir Joseph Whitworth & Co., Manchester.

A foundry for steel casting is now being added to the plant at Elswick.

Heretofore the gun-carriages for both the army and navy have been provided from the gun-carriage department at Woolwich on their own designs; but since the adoption of the Vavasseur gun-carriage by the Admiralty, the works at Elswick, as well as the London Ordnance Works of Mr. Vavasseur, have been called upon to supplement Woolwich in the production of a supply of these carriages. At the present time the Admiralty have on hand, or under construction, about 450 of them suited for all calibers of guns.

CONDITION OF STEEL MANUFACTURE.

The Board visited the following works, viz:
Thomas Firth & Sons, Sheffield.
Sir John Brown & Co., Sheffield.
Charles Cammell & Co., Sheffield.
Vickers Sons & Co., Sheffield.
Sir Henry Bessemer, Sheffield.
Sir Joseph Whitworth & Co., Manchester.
Bolckow, Vaughan & Co., Eston.

Until within a very few years, the steel for gun metal has been confined in England to that produced from crucibles, and it is only since the general application of the Siemens-Martin Process that Open-Hearth steel has come into competition with it. The uniform results that are now attainable with this process show that the period for the exclusive use of crucible steel for cannon has passed. Some of the steel manufacturers have advanced very far in the use of the open-hearth, and all are making arrangements for embarking in this system of manufacture. This process is much cheaper than that by the crucible, and, its success being established, that reason alone would be sufficient to cause the change in the system; but there are other reasons now operating in England which make the change of manufacture necessary in order that the steel works shall retain their position in commerce and be enabled to answer the calls made on them by the Government.

As long as the demand for steel was confined to orders which required small ingots, the product of the crucibles was sufficient, and the force of laborers required was not excessive; but since the introduction of steel into the process of forming armor-plates, and the corresponding increase in the size of parts requisite for the guns to pierce the new armor, the organization of a force to cast, from crucibles, masses to answer these demands has become a difficult matter. The changes that were commenced a few years ago in some, and which are now being introduced in all the works at Sheffield, are necessary to prevent the purchase from other sources of the masses of steel now required by the Government.

The new departure in the system of gun construction, described farther on in this report, will demand from the Sheffield steel manufacturers increased effort. Up to the present time the only portion in the construction of the Woolwich gun that required steel was the tube; the breech-pieces and hoops, being made of coiled wrought iron, were fabricated at Woolwich. The new construction requires that steel shall be used throughout, and the castings for the jackets for guns now in hand at Woolwich can hardly be supplied from Sheffield. It is well known that the tubes for the 100-ton guns, manfactured at Elswick by Sir

William Armstrong, which required an ingot of 42 tons, had to be made in two pieces because the capacity of Sheffield was not sufficient to make the casting in one, and it is fair to suppose that the use of the *coiled steel* breech-pieces, now used at Woolwich to build up the 43-ton gun, was induced by the difficulty of procuring masses of steel of sufficient magnitude to make proper jackets for them. If this be not the case in regard to the 43-ton guns, the embarrassment is very likely to arise with the 62-ton steel gun now in contemplation. But whether any serious embarrassment has yet arisen or not, owing to the limited capacity of Sheffield for casting gun metal, it is evident that whatever margin the manufacturers now have, it is very slight, and it behooves them to increase their plant for casting.

The question of *forging* steel ingots is one which is evidently occupying the attention of the steel manufacturers in Sheffield, but on which they are reticent. The important works are all supplied with steam-hammers of greater or less weight, varying from 15 to 25 tons, and each manufacturer claims that his works are thoroughly equipped in this respect for accomplishing the necessary work on an ingot of any size; but it was observed that in one important establishment preparations were being made for the introduction of a large press to take the place of, or to supplement the work of, the hammer. The success of Sir Joseph Whitworth's process of forging by hydraulic compression, and the enviable character acquired by the products of his works in Manchester, have induced the Sheffield manufacturers to take into consideration the probable advantages of the process. As to the advantage or practicability of the compression of steel in the liquid state they are entirely skeptical, but the efficacy of forging under hydraulic compression is conceded, though it is claimed that this must be done under a heat much higher than that required for forging under a hammer, which is considered an objection to the process.

Owing to the character of seclusion that Sir Joseph Whitworth has preserved to his works, the manufacturers of steel at Sheffield have no personal knowledge of the process adopted at Manchester. Their knowledge is limited to meager reports, but the Board was allowed the privilege of carrying on its investigations within the works where, under orders from Sir Joseph, his representatives exhibited, with explanations, the operations carried on in this unique establishment. It may be distinctly asserted that the experiences enjoyed by the Board during its visit amounted to a revelation.

Whitworth's Works.—Upon its first arrival in London the Board was invited by Sir Joseph Whitworth to examine his works, but with the desire expressed that the visit should be postponed until the close of our foreign investigations. This request was, of course, readily acceded to, and it will be thus seen that previous to the visit to Manchester the members of the Board had received all the impressions that could be produced by viewing the operations at the chief steel factories in France and Russia, and the great factories of Sheffield, in England.

In speaking of the Whitworth establishment at Manchester as unique, and of the process of manufacture at that place as a revelation, reference is specially made to the operation of *forging*. As to the assorting of ores, and the treatment of metal in the furnaces, there is no intention to draw distinctions; but as to the treatment of the metal after casting there can be no doubt of the superiority of the system adopted by Sir Joseph Whitworth over that of all other manufacturers in the world. The process here adopted has been kept singularly exempt from scrutiny. Even in the offices of the chiefs of artillery there can be found no in-

formation, within the knowledge of the Board, which is at all satisfactory upon the subject. Whatever knowledge there is seems to come from hearsay—none from personal observation—and it is only from personal observation that the merits of the system can be fully appreciated.

The system of forging consists in compressing the liquid metal in the mould immediately after casting, and in substituting a hydraulic press for the hammer, in the subsequent forging of the metal.

The flask is made of steel and is built up of sections united by broad flanges bolted together in such numbers as to accommodate the length of the ingot to be cast. All moulds are cylindrical in form. The interior of the flask is lined with square rods of wrought iron, longitudinally arranged, which form when in place a complete cylindrical interior surface. Where the square edges of these rods meet they are cut away, both on the inside and on the outside, and, at intervals of two inches, small holes are drilled through between the rods, forming a channel-way from the interior to the exterior for the passage of gas and flame. The interior is then lined with moulding composition. The flange at the bottom of the flask, as well as that at the top, is perforated with small holes which act as a continuation to the perforations between the segments of the lining for the escape of gas.

The casting is made directly into the mould from the top. On the completion of the casting, the mould is moved (by means of a railway at the bottom of the casting-pit, which is a deep trench running parallel to the position of the furnaces) to a position under the movable head of the press, which is allowed to descend until the top is in contact with the metal in the mould, and in this position it is locked; a shower of metal is induced, which ceases almost as soon as commenced, by the complete closing of the mould. The first impress felt by the metal is due to the weight of the head of the press alone. This pressure is gradually increased from below by hydraulic action, applied by four rams upon the table on which the flask rests, until the pressure exerted amounts to 6 tons per square inch. The interval from the commencement of the pressure until the maximum is reached varies with the size of the ingot, being for a 45-ton ingot as much as 35 minutes. During this time the flow of gas and flame from the apertures in the flanges of the flask, at top and at bottom, are continuous and violent, exhibiting the practical effect of the compression. This pressure is applied by the direct action of steam and pumping engines, and is indicated by a dial. At the end of this time the pump is taken off, and a uniform pressure of about 1,500 pounds per square inch is established by attaching an accumulator to the press, and allowed to remain until the metal is sufficiently cooled to insure no farther contraction in the mould.

The contraction in length in the mould during the action of the pump, while the maximum pressure is being reached and sustained, amounts to one-eighth of the length of the ingot. After this effect has been produced, there is no farther advantage derived from the pressure in the way of eliminating impurities, but the contraction, in cooling, still goes on, and the pressure by the accumulator is considered necessary in order to follow up the metal as it contracts, for the purpose of preventing cracks being inaugurated at the end and on the exterior of the ingot by the adhesion of particles of the metal to the sides of the mould.

When cooled and reheated, the ingot is brought under the influence of the forging-press. This press is hydraulic, with a moving head having the main hydraulic cylinder fixed in it, and it is provided with an arrangement of mechanism for raising and lowering the moving head of the press and for locking the same in any desired position.

The press has four hollow pillars screwed part of their length, which are attached to the base of the press by nuts. On the top of the pillars is fixed a cast-iron head or table supporting two hydraulic lifting cylinders, the rams of which are fitted with cross-heads carrying four suspension bars. These bars pass through the moving head, and are connected at the lower ends by cross bars, which are fastened to the pressing ram. The moving head works between the base and the top or fixed head of the press, and is raised or lowered by the admission or exit of water from the underside of the rams of the lifting cylinders. The moving head can be firmly and rapidly locked at any height from the base which may suit the work to be operated upon. The moving head, as already mentioned, carries a forging or compressing cylinder, which forces a ram down upon the work. By attaching the compressing cylinder to, and making it part of, the moving head, a short stroke can be employed when forging objects which may vary in size from a few inches to several feet in diameter.

This in general terms explains the working of the ram. The effect produced by it requires to be seen in order to be thoroughly appreciated, and is altogether different from that produced by the hammer. The heated ignot resists the blow of the hammer, but the insinuating, persevering effort of the press cannot be denied. The longer time (several seconds) during which the effort lasts is a great element in its successful effect. As pressure succeeds pressure the stability of the particles is thoroughly disturbed and a veritable *flow* of metal induced, which arranges itself in such shape as the pressure indicates; the particles are forced into closer contact and the whole mass writhes under the constraint which it is impotent to resist.

The Board witnessed the operations of casting followed by that of liquid compression, the enlarging of hoops, the drawing out of cylinders, and the forging of a solid ingot. The unanimous opinion of the members is that the system of Sir Joseph Whitworth surpasses all other methods of forging, and that it gives better promise than any other of securing that uniformity so indispensable in good gun metal.

The latest exhibition of the wonderful character of the Whitworth steel has attracted great attention, and may be stated as indicating the present culmination of his success. From a Whitworth 9-inch gun, lately constructed for the Brazilian Government, there was fired a steel shell, which, after perforating an armor-plate of 18 inches of wrought iron, still retained considerable energy. The weight of the shell was 403 pounds, the charge of powder 197 pounds, and the velocity about 2,000 feet. The shell is but slightly distorted. The tests of the metal of which it was made show a tensile strength of 98 tons per square inch and a ductility of 9 per cent.

Basic Process.—The manufacture of steel as treated in the Bessemer converter came under the particular notice of the Board at the works of Sir Henry Bessemer, in Sheffield, but nothing in the practice deserving of special remark was observed with the exception of the use of a mechanical stirrer, which is inserted into the molten metal in the ladle after the recarburating charge of spiegeleisen has been added. The stirrer is, in form, a two-bladed propeller on the end of a vertical shaft, actuated by a geared engine of 6 horse-power, conveniently placed at the side of the casting pit. The revolutions of the stirrer have the effect of more thoroughly incorporating the spiegeleisen with the charge, disseminating it throughout the mass.

No product of the Bessemer converter has yet been found to answer all purposes for gun construction; it has been used with success for

hoops for light guns, but it is deficient in the hardness required for tubes and has the reputation of want of uniformity. Extensive experments were made in France several years ago with this metal, with a view to adopting it for gun construction, but failure after failure caused the abandonment of the effort. Those who are laboring to perfect this process insist that great improvements have recently been made, and that the character of want of uniformity is no longer deserved. Should final success attend these efforts, there will be a probable future of great usefulness opened up for the numerous phosphoric ores in the United States, as the Bessemer converter is found to be a most convenient means of applying dephosphorizing elements to these ores when in a state of fusion. For the purpose of investigating this matter, the Board visited the extensive works of Bolckow, Vaughan & Co., near Middlesbrough, where, under the guidance of Mr. E. Windsor Richards, the manager, the manufacture by what is termed the "Basic Process" was witnessed.

This immense establishment is located at Eston, 5 miles from Middlesbrough, and there is evidence of great executive ability guiding the details of its conduct. The company owns very extensive territory adjoining the works and tributary mining districts of coal and ore, and employs fourteen thousand men. At Eston there are twenty-six blast furnaces; 11,000 tons of pig-iron are cast per week, and, in addition to other fuel, there is a weekly consumption of 13,000 tons of coke; 8,000 tons of coal and 7,000 tons of ore are raised per day.

One point may be mentioned in connection with the manufacture of steel rails at this establishment. The iron is not cast into pigs, but is carried direct from the blast furnace to the Bessemer converter; after casting, the ingot is removed at the earliest possible moment from the mould, and after a short reheating is carried to the rolls, from which it comes out in the form of a finished rail, the whole operation being completed in one heat.

Ten Bessemer converters are in operation, six worked by the Basic Process and four on the usual Acid Process, with a siliceous (ganister) lining.

In the Basic Process the converter is lined with a mixture of dolamite (magnesia limestone), calcined, pulverized and incorporated with coal-tar to make it pasty. The converter is taken to pieces and lined with this mixture 18 inches thick. Before lining the bottom, through which are the perforations for the passage of air during the operation of blowing, long rods are inserted in the holes and the mixture is packed around them. When this operation is completed the rods are removed, leaving holes through the bottom lining. The pieces of the converter are then assembled, and a fire is lighted on the inside to burn out the coal tar on the inner surface; the whole lining then has a set. One lining of the sides is good for 40 or 50 blows; one lining of the bottom is good for 10 blows.

The converter being in place and heated, a charge of pure, common lime, unslacked, is introduced (15 per cent. of the charge of iron). The molten metal, brought from the blast furnace, is then poured in and the blow commenced. When the phosphorus is removed, which is ascertained by mechanical tests, about three-fourths of the charge is emptied into the ladle, in which ferro manganese has been previously placed; a charge of 4½ per cent. of molten hematite, imported from Spain and containing from 2½ to 3 per cent. of silicon and a mere trace of sulphur and phosphorus, is then brought from a cupola furnace and poured into the ladle, causing a violent ebullition; this goes on for a

time, more ferro-manganese being added, if necessary, to prevent red-shortening. When the boiling ceases, 4½ per cent. of spiegeleisen is poured into the ladle, which is then brought again under the converter and receives the rest of the charge. The casting is then made from the ladle.

The ore used in this process is of very inferior quality; it is called Cleveland stone, has 42 per cent. of iron and high phosphorus, the pig containing 1½ per cent. Being very low in silicon it does not destroy the lining, which would be the case if silicon was high. The object of the lime is to take up and hold the phosphorus in the slag. The phosphorus is increased in the charge by adding some of the old slag, making the proportion of phosphorus 1.75 per cent. The amount of silicon in the iron is from 0.75 to 1 per cent. During the operation of blowing this silicon is the first to disappear; the carbon is then consumed, immediately after which the phosphorus passes into the slag. This operation requires about 2½ minutes and is timed from the moment the collapse or falling of the flame shows that the carbon is burned out.

Mr. Richards stated that previous to the introduction of the charge of hematite during the operation there was a want of uniformity in the results; that sometimes there would remain traces of phosphorus, but that the introduction of the pure hematite, which has only a trace of phosphorus and is high in silicon, before casting gives such stability to the mass as to prevent the slag from parting with any of the phosphorus it has taken up; the silicon also in the hematite is oxidized in calming down the steel, and it also goes into the slag. The introduction of the hematite also makes it possible to halve the ordinary charge of spiegeleisen, which, as spiegel is costly, cheapens the operation.

The Basic Process, thus briefly sketched, has for its object the utilization of inferior ores. It is the only one now known by which this injurious element, phosphorus, can be eliminated. For guns the natural prejudice would be against metal made from ore which was originally defective, but the operators of this system hold that their product is as good as if made from pure ore. Whether it will ever be used for gun metal will depend upon the confidence that it may inspire in the future, but the problem of its application for general purposes has been successfully solved.

PRESENT CONDITION OF THE ENGLISH ARTILLERY.

It is well known that the essential characteristics of the Woolwich gun were that it was a muzzle-loader and depended for its strength upon wrought-iron coils. The security of muzzle-loading and the safety derived from the wrought iron used in the construction of the gun have been claimed as advantages over other constructions.

At the time of the visit of the Board to England it was found that a great change had taken place in the opinions of the English artillerists on these two points, and that the military and naval services were changing the character of their armaments. The first effort was directed to the substitution of the breech-loading system. This was induced by the increasing difficulties attending the loading of large guns at the muzzle both on shore and at sea. Adherence to the practice of muzzle-loading had imposed much additional expense for machinery necessary for manipulation, and the ever-increasing length of guns and weight of projectiles complicated the difficulties. It was determined that attention should be given to the question of applying the breech-loading principle to guns, and in 1879-'80 plans were made for such

constructions and the experiments were inaugurated which promise to involve an entire change in the armament of the country.

Although the idea of introducing the system of breech-loading seems to have been forced by the difficulties attendant upon the use of large calibers, the effort is now being made to apply the change to all calibers. The Board found that in the gun factory at Woolwich, guns of all calibers were being fitted on the breech-loading system.

One of the first experiments tried was with a 12-inch 43 ton gun, manufactured at Woolwich, which was built of wrought-iron coils and fitted with the French fermeture, necessarily inserted in the rear of the steel tube. Good ballistic results were obtained, but the construction of the gun does not seem to have given satisfaction. At the same time some experiments with 6-inch breech-loaders were carried on. These were built up in the same way; several failed, some of them after being fired with battering charges. The reasons assigned refer to bad metal and to errors in manufacture. These failures, however, seem to have convinced the authorities that it was not wise to continue the use of coiled wrought-iron hoops and breech-pieces, and the Board finds that with the adoption of the system of breech loading there is a positive move to the use of steel for all parts of their gun construction.

The guns under construction at the Woolwich Gun Factories indicate that this conclusion has been accepted by the Government, though the differences perceptible in some of them show the gradual growth of the developed idea. For example, though the 12-inch 43-ton gun of latest order is composed entirely of steel, there are other guns of the same caliber and weight which have a portion of their hoops made of wrought-iron coils. There is no doubt, however, that the use of wrought iron and the system of muzzle-loading have been abandoned.

In addition to the 12-inch 43-ton steel guns, there are in hand 13-inch 62-ton steel guns; also 10-inch 26-ton steel guns designed to throw a projectile of 500 pounds with an initial velocity of 2,100 feet. Much interest is also felt in the success of the 9.2-inch 18-ton steel gun, which is designed to supersede in sea service the present 10-inch 18-ton wrought-iron muzzle-loader. Four 8-inch 11½-ton steel guns are being manufactured in the Royal Gun Factories; two of them will be 30 calibers in length and two will be 26 calibers in length, the shorter being intended for sea service. Breech-loading guns of 6-inch, 5-inch, and 4-inch calibers are also now constructed of steel.

In this transition from wrought iron to steel it must be particularly noted that the change as thus far made in large guns consists in the substitution of coiled steel for coiled wrought iron; the reason for taking this intermediate step being the want of experience at the Royal Gun Factories in the manufacture of solid steel hoops, and the greater certainty of the manufacture of the steel coils. The superiority in strength of the steel coil over that of wrought iron is positively claimed by the superintendent. Jackets (breech-pieces) and hoops of forged and rolled steel are to be used as soon as practicable.

What has been recognized by the world as the Woolwich system no longer exists in practice. In its place we find the Vavasseur design, a gun composed of a steel tube, with a steel jacket (breech-piece) supplemented by superimposed layers of steel hoops. This change has been brought about by public opinion, which has asserted itself in condemnation of the material and the system of construction so long in use.

Material.—It is stated by a very high authority that wrough iront welded into such large masses as are required for the Frazer system loses its fibrous character and becomes highly crystalline.

The use of the coiled steel hoops, adopted as a temporary expedient at Woolwich, is objected to by high authorities, who, while allowing that steel of an extremely mild quality might be used for welding coils, say that it would be no better than iron, and that at the point of welding no greater strength than that due to iron can be obtained.

All authorities concur that steel, superimposed in layers over an inner barrel, is the best material for ordnance, and the preponderating testimony favors its manufacture by the Open-Hearth Process. This is not due to any objection to crucible steel, which has heretofore been used for all gun-tubes, but because the results of the Open-Hearth Process are equally satisfactory and cheaper. Even those who insist in retaining crucible steel for tubes are willing to adopt the Open-Hearth steel for jackets and hoops.

There is a difference of opinion as to the mode of manufacture of the hoops and jackets. All agree that small hoops should be rolled after having been forged into a ring shape from a cast ingot; but for larger hoops and jackets it is recommended by some that they should be cast hollow and then forged, and by others that they should be cut from a solid ingot and forged; while still another authority thinks that hoops and jackets of large size should be bored out of the solid after forging.

Construction.—In the latest designs for steel guns the system of Mr. J. Vavasseur has been adopted. This consists of a tube as thin as is consistent with strength; a long jacket shrunk on to provide longitudinal strength; and layers of superimposed cylinders or hoops shrunk on, the number of layers varying with the size of the gun. The thin tube develops more thoroughly the principle of a built-up gun, and is less liable to contain concealed defects. It makes the ultimate strength of the gun less dependent on its integrity.

Sir William Armstrong advocates a greater number of layers than Mr. Vavasseur or the superintendent of the Royal Gun Factories. The latter agree that the thickness of the layers should not be reduced to a point where the mass is not sufficient to compress the structure under it in process of cooling.

Sir William Armstrong considers that he increases the end-strength of the layers of his guns by interposing sheet copper between the surfaces, and states that copper has been used in this way at Elswick for two or three years. The superintendent of the Royal Gun Factories and Mr. Vavasseur object to the use of copper as rendering the compression due to shrinkage uncertain in amount. They prefer to rely for end strength on hooking the layers together. In their latest designs the chase of the gun is not reinforced, but depends for its strength on the thickness of the steel tube. Sir William Armstrong, however, considers it desirable to extend the hoops to the muzzle of the gun to provide against the possible premature bursting of a shell in the bore.

The *pressures* to which the guns will be permitted to be habitually subjected will not exceed 18 tons to the square inch.

The propriety of lining the tube with a thin steel lining is being closely considered for the purpose of providing a plan for renewing the portions of the metal scarred by firing without having to resort to retubing. There is no doubt that experiments will be made in this direction.

Breech-Closing.—All the authorities in England now advocate the breech-loading system for cannon. The interrupted screw, commonly known as the French system, is preferred and has been adopted at Woolwich. In the heavier guns, at least, the breech screw will not engage in the tube, but in the cylinder immediately surrounding it, thus relieving the tube from that portion of the longitudinal strain which

tends to blow out the breech. The number of interruptions increases with the caliber; there are four in the breech mechanism of the 12-inch 43-ton gun.

Gas-Check.—The de Bange gas-check has been adopted at Woolwich and is preferred by Mr. Vavasseur. It is considered as complying more nearly than any other with the conditions required of a perfect gas-check. It requires no seat to be prepared for it in the chamber, is not liable to derangement, and does not require perfect accuracy in its manufacture. Sir William Armstrong adheres to the Elswick cup, as opposed to the Broadwell ring, and objects to the de Bange gas-check because of the additional length of gun required; in the 12-inch 43-ton gun this amounts to 6 inches.

Vent.—The vent is in the axis of the gun and the escape of gas through the orifice after firing is checked by a device by which a plug is drawn into the neck of the primer by the action of pulling the laniard attached to the friction tube.

Form of Chamber.—At the Royal Gun Factories it is considered that the best results are obtained with chambers not more than 3½ diameters in length, and with an opening the full diameter of the chamber. Sir William Armstrong, though preferring a long narrow chamber as being favorable to strength of tube, thinks that under the present aspect of the powder question the short, wide chamber, with full-sized opening, must be adopted.

Rifling.—All the authorities except Sir Joseph Whitworth, who adheres to the polygonal system, agree that the grooves should be numerous and shallow. The rifling is polygroove; the grooves are cut to a depth of 0.05 inch, and their non-driving edges are sloped to diminish the scoring. The twist is an increasing one (from about 1 in 120 calibers to about 1 in 35 calibers) for about half the length of the rifling; the other half, to the muzzle, being a uniform twist of about 1 in 35 calibers. The number of grooves is determined by the caliber and is the product of 4 and the diameter expressed in inches; thus, the 12-inch gun has 48.

Rotating Rings.—The Vavasseur rotating ring is now adopted by Woolwich and Elswick, the dimensions being determined by experiment. Mr. Vavasseur lays great stress on the position of the rotating ring on the projectile. He states that it should be at the center of percussion with respect to the front bearing.

Wire Construction.—The employment of steel ribbon or wire in gun construction has been more or less considered since 1855, when Mr. James A. Longridge brought to the notice of the War Office his proposed method of increasing the strength of guns by this means. Some experiments were made, but they were not satisfactory. Of the strength that was given circumferentially there was no doubt, but the difficulties of providing it longitudinally were so great that the subject was dropped at the time. Recently, however, the matter has been taken up by Sir William Armstrong, who has manufactured several wire guns.

A 10.2-inch gun of this manufacture has been purchased by the War Office and is now under trial. In this gun longitudinal strength is obtained by disposing some of the wire lengthwise around the tube, and some very satisfactory experiments have been made with it. The gun weighs 21 tons, is 25 calibers long, and the following present some of the particulars of the last reported firing:

Charge of powder	pounds..	220
Weight of projectile	do....	404
Muzzle velocity	feet..	2,160
Pressure per square inch	tons..	17

A 6-inch breech-loading gun and a 6.3-inch muzzle-loading howitzer manufactured by the same firm are also about to be tried. In these the longitudinal strength is entirely dependent on the steel tube. The same firm is manufacturing several 6-inch breech-loading guns in which the longitudinal strength is partially provided for by a jacket, the wire wrapping being only called upon to provide circumferential strength.

The Royal Gun Factory has taken up the subject and has matured designs for experiment on a large scale. In its designs the longitudinal strength is obtained by means of steel segmental hoops placed between layers of wire.

The following is the present state of the wire gun question in England:

Manufacture of Sir William Armstrong:
  Under trial, 10.2-inch breech-loading gun.
  To be tried, 6-inch breech-loading gun, 6.3-inch muzzle-loading howitzer.
Manufacture of Royal Gun Factories:
  Under manufacture, 10-inch breech-loading howitzer.
  Recommended for manufacture, 15-inch breech-loading gun of 63 tons.

Opinions vary as to the form, size, and other characteristics of the wire. One authority recommends square wire for the first six or eight coils, gradually increasing the size of the wire as the coils proceed outwards. This authority states that the higher the elastic limit the better, the breaking strain and power of elongation being of comparatively small importance, and that the wire should never be strained up to its elastic limit. Another authority recommends a flat wire of 100 to 110 tons breaking strain wound on a tension of 60 tons for the inner and about 70 tons for the outer layers, the longitudinal strength to be provided by the inner tube of the gun and by steel segments divided longitudinally, but, when put together, forming a tube. Another authority states that the full benefit of wire cannot be obtained unless strained beyond its elastic limit. Another authority prefers wire of a circular section, it being impossible to keep any other shape to gauge. For heavy guns he would use wire of 0.0984 section, with a breaking strain of about 125 tons, and an elongation of about 2 per cent. This authority says that the elastic limit of the wire should not be passed in winding it on. He estimates that there would be a saving in weight of about 30 per cent. on the breech portion of the gun, and more certainty of manufacture than with steel hoops.

FRANCE.

SOURCES FROM WHICH THE ARMAMENT OF FRANCE IS SUPPLIED.

Previous to the Franco-German war of 1870, it was the custom in France to confide all matters relating to cannon to the artillery corps of the army and navy; aid from private sources was neither sought nor offered; much secrecy was observed in all things relating to the business of ordnance; admission to the Government foundries was obtained with difficulty, and the experimental ground at Gâvre, with rare exceptions, was closed to all applicants.

For army purposes, the gun factories at Bourges, Puteaux, and Tarbes supplied all demands, while for the use of the navy the foundries of Ruelle and of Nevers, and the gun factories attached to them, provided the entire armaments.

With the advent of the war came the proof that a close corporation, such as was constituted by the system heretofore adopted, could not work to the best advantage of the country; and, with the return of

peace and the necessity of re-armament, came a revolution of ideas which has led the Government to modify its practice.

It was recognized that the Government must have under its control some establishments purely governmental; but that, in order to provide for all contingencies as well as to prevent official ideas from running too much in a groove, it was desirable to encourage private industries, so that a spirit of emulation might be excited by competition and a channel afforded through which new ideas and inventions might reach the national works. The adoption of this course was made the more imperative in consequence of the new departure in gun-metal, and this opened the way to the encouragement of the steel industries of the country.

The plan thus decided on has been consistently carried out. The Government gave assurances to the private companies which induced them to expend the funds necessary to erect new and suitable tools, both for the casting of the metal and the fabrication of the guns.

The result of this action can be appreciated by reference to the following list of private companies which are now employed in providing armaments for the Government.

STEEL MANUFACTORIES PRODUCING STEEL UP TO TUBES FOR 16-CENTIMETRE GUN

Jacob Holtza & Co	Unieux (Loire).
Marrel Frères	Rive de Gier (Loire).
Société des Acieries et Forges de Firminy	Firminy (Loire).
Compagnie des Forges et Acieries de St.-Étienne	St.-Étienne.

STEEL MANUFACTORIES PRODUCING STEEL UP TO TUBES FOR 42-CENTIMETRE GUN.

Henri Schneider & Co	Le Creusot.
Acierie de la Marine	St.-Chamond.

PRIVATE COMPANIES HAVING PLANT OF GUN FACTORY.

Henri Schneider	Le Creusot.
Cail & Co	Paris.
Société des Forges et Chantiers de la Méditerrannée	Havre.
Compagnie de Fives-Lille	Fives-Lille (Nord).
Société Anonyme de Constructions Navales du Havre	Havre.
Acierie de la Marine	St.-Chamond.

STEEL MANUFACTORIES PRODUCING ARMOR PLATES.

Henri Schneider & Co. (forged steel)	Le Creusot.
Acierie de la Marine (compound)	St.-Chamond.
Marrel Frères (compound)	Rive de Gier.
Chatillon et Commetry (compound)	Montluçon.

The compound plates are manufactured under the patent of Mr. Wilson, of Charles Cammell & Co., Sheffield, England.

All the gun-carriages for the navy and for the coast defense are made at private works.

The above lists illustrate the immense increase of resources that the Government has obtained by encouraging private industries, and they contribute an important historical chapter for the instruction of a Government about to provide an armanent for its military services.

The following is the list of the Government works manufacturing for the army, viz:

(1.) Fonderie de Canons à Bourges, in the center of France. At this place stee guns are made of 90 millimetres, 155 millimetres, 100 millimetres and 240 millimetres; also rifled mortars of 220 millimetres.

(2.) Atelier de construction à Tarbes in the Hautes Pyrenées, in the southwest

part of France. At this place steel guns are made of 90 millimetres, and 120 millimetres; also carriages for field and siege guns.

(3.) Atelier de Construction de Puteaux, near Paris. At this place all the steel mountain and field guns of 80 millimeters are made; also siége guns of 120 millimetres, and the Hotchkiss revolving cannon for flank defense.

(4.) Gun carriages, limbers, &c., are made at Government shops at Vernon, Avignon, and at Angers.

Gun-carriages are also manufactured for the army at private works.

Bourges.—The gun factories of the army fabricate no guns above the caliber of 24 centimetres, and it is only at Bourges that army guns of this caliber are constructed. At the private establishments mentioned above the work of fabrication has been carried as high as 34 centimetres, but the advantageous working capacity of the factories does not extend beyond the 24-centimetre gun.

Ruelle.—At the "Fonderie à Ruelle" all the constructive force of the marine artillery has been concentrated, and here all the largest guns are made. It contains the most remarkable collection of tools of the age. They are designed for guns of 34 centimetres and upwards, and have a capacity for handling guns of 160 tons in weight and 60 feet in length. The shop in which these tools are placed is about 450 feet in length and 131 feet in width, having a height of 85 feet at the central peak of the roof. At one end is the tubage pit, in which the gun tube is placed upright to receive the hoops. The bottom of this pit is at a depth of 85 feet below the floor. It is excavated in a rectangular form and is divided into four stories, contracting in area as the lower level is reached; at each story or landing place, the opening can be floored over to accommodate the work of hooping any length of tube. The heating furnaces are on the first story below the floor. The tools already in place are the following, but there is room for fully a dozen more of similar character:

Two turning lathes, capable of turning guns 15 metres long. These can be increased in length 10 metres.

Three boring machines for same.

One rifling machine for same.

Two smaller boring machines with adjustable connections for turning.

Two other machines for performing all the details of the work about the breech, for receiving the fermeture, turning the screw, slotting, piercing holes, &c.

Two movable cranes; one of 100 tons, the other 30 tons capacity.

The contractors for these tools were Varall, Elwell & Middleton, Paris. The plant has cost millions of francs, and five years elapsed from the giving of the order to the setting up of the tools. A large portion of the time charged to the manufacture must be credited to the preparation of designs, no tools of their size and great capacity having been before conceived.

Taking the above short notice of the works at Ruelle in connection with what has been stated on the subject of private industries, it will be seen how well all the requirements are provided for a joint production of cannon by the Government and private parties. The latter assist up to a point justifying on their part a reasonable outlay of money for a plant, and the Government, though working in this common field as well, yet reserves to itself all the more onerous charges involved in the manufacture of the heaviest ordnance.

It seems as if in France the happy mean has been reached by which the Government and the private industries can work harmoniously towards the accomplishment of a national object.

In a combined system of this kind, it is very important to be assured that there exist mutual checks which act to prevent the one party im-

posing improper or hard terms on the other. The Board is not without evidence of the existence of these salutary checks in France.

A short time since the Government deemed it necessary to increase its armament by 300 additional guns, and decided that certain additional tests should be required of the metal for the tubes. When the provisions of the proposed contract were made known to the steel manufacturers, they resisted the requirements as being too hard and insisted on the acceptance of such steel as had been previously supplied; but to this the Government would not accede. Finding them determined in their resistance, the Government made inquiries abroad as to the possibility of securing the metal it required, and, finding that a foreign manufacturer would undertake the contract, a promise was given to him that he should receive the order. The steel manufacturers of France, hearing that the order was likely to be given to a foreign firm, endeavored to arouse a national feeling on the subject to constrain the Government to make the purchase in France, but to no effect; and they finally proposed to accept the Government proposition. But the minister had already given his word to the foreign manufacturer and the contract was lost to France. In this instance both parties, the Government and the private companies, acted within their independent rights, but neither could compel the other. This exhibition of effective counterpoise is a good proof of a happy adjustment of forces.

CONDITION OF STEEL MANUFACTURE.

Since the termination of the Franco-German war of 1870, and in the course of the re-armament of the country, the Government has given every encouragement to private industries to justify them in incurring the expense of establishing plants at various points to assist in the construction of guns; and by embarking largely in the fabrication of *steel* cannon it has given a great impetus to the manufacture of this important material. The numerous works that can produce metal suitable for tubes and hoops for field-pieces have been mentioned. These establishments have made a study of the subject of gun-metal, and, so far as their facilities for forging reach, can all supply the demands that the country can make upon them.

For tubes and hoops, however, for large guns, requiring massive forgings, the supply is limited to the works of the "Compagnie de l'Acierie de la Marine" at St. Chamond, and to those of H. Schneider & Co. at Le Creusot, the former having a steam-hammer of 80 tons, and the latter one of 100 tons weight.

There are some establishments, notably at St. Etienne, where crucible steel of a high order is manufactured for purposes of trade, but no effort is made to utilize it for gun purposes.

St. Chamond.—The cast steel used for cannon in France is manufactured by the Open-Hearth Process with Siemens furnaces. This process is combined with the rotating bath of M. Pernot at St. Chamond, where three 25-ton and two 12-ton Pernot furnaces give a capacity for casting an ingot of 100 tons.

The ingots cast here for the 42 centimetre 75-ton guns are of 75 tons weight; the tube, after rough boring and turning, weighs about 35 tons.

The tempering-pit is a large excavation 15 metres deep. At one extremity is the furnace where the tube is placed erect and heated. At the other is a cylindrical excavation, reaching to 15 metres below the floor of the pit, where is placed the tank containing 100 tons of colza oil into which the tube when heated is lowered rapidly.

Le Creusot.—The most important steel works in France are situated at Le Creusot and bear the name of the location in which they are situated. These works have advanced year by year in importance and in magnitude since their purchase by Mr. Eugene Schneider.

This gentleman's death, in 1875, was a source of mourning to the whole town, the inhabitants of which looked up to him as a father. The grateful people have erected to his memory a monument in the market square.

Under the administration of his son, Mr. Henry Schneider, the fame of the products of the works has been enhanced, and the proportions of the establishment have been much increased. The whole number of workmen now employed here and at other points amounts to 15,000; and it is the great center of industry of the adjoining region. At no other place in the world is steel handled in such masses.

It would be foreign to the purpose of this report to dwell on the many objects of commerce which are supplied from these works, but it is safe to say that no proposed work can be of such magnitude as to exceed the resources of the establishment.

For the preparation of metal for cannon and armor-plates Le Creusot is thoroughly equipped. The iron is produced on the premises from the purest imported ores, and the manufacture of the steel is carried on by the most approved application of the Open-Hearth system with the Siemens furnace; the chemical and mechanical tests are such as to satisfy the most exacting demands of careful Government officials, and the executive ability apparent in all the departments and the evident condition of discipline that pervades the whole establishment inspire confidence in the productions of the labor.

The capacity for casting steel is represented by seven open-hearth furnaces of 18 tons each, equal to 126 tons; and the process of casting large ingots is a model of order and security. Ladles capable of holding the contents of one furnace, mounted upon platform cars, are successively filled at a previously determined interval of time and run on railways to a convenient position over the mould; before the first ladle is exhausted the supply from the succeeding one has commenced to run, and so on to the completion of the casting, the supply to the mould being uninterrupted during the entire process. The precision with which the several ladles are brought into position in succession makes it entirely unnecessary to provide a common reservoir into which all the furnaces may discharge. By this process the casting of a 45-ton ingot, which was witnessed by the Board, was effected in 23 minutes.

The process of tempering the gun-tubes was also witnessed by the Board. The excavation of the pit is, as at St. Chamond, 15 metres deep, with the furnace at one end and the oil tank (100 tons) at the other. One side of the upright furnace is constructed in the form of a door, which, by a convenient arrangement for swinging, is made to turn on its hinges. Thus, when the tube is raised to the right temperature, it is seized by the traveling-crane, the door of the furnace swung open, and the tube at once advanced to the tank in which it is immersed.

All tubes are immersed in oil the second time, but at a temperature much below that to which they are raised at the first immersion. This process constitutes the annealing after tempering.

The manufacture of steel-armor plates is a specialty of Le Creusot, which is engaged in an active competition with the manufacturers of compound armor. Plates up to 60 centimetres in thickness and 3 metres wide are forged here; they are tempered after forging, but what subsequent treatment they receive was not explained.

The tempering-pit for the plates consists of an excavation of convenient size, in the center of which is placed a tank containing 180 tons of oil. At the four corners of the pit are furnaces in which the plates are raised to a proper temperature. When sufficiently heated a plate is seized by a walking-crane and immersed in the oil.

Hoops for cannon are manufactured here in large quantities. They are cut from solid ingots, and those for guns up to 24 centimetres are rolled like railway tires; those for larger calibers are forged on a mandrel. Jackets of large size are also manufactured; these are made from solid ingots, which, after being forged, are bored out.

At Le Creusot a remarkable test of hoops was witnessed which exemplifies not only the excellence of the manufacture of the steel but also the exacting character of the French requirements. The hoops for naval guns are made with the interior surface slightly conical. When forged, turned, and brought under a hammer, a standard mandrel of steel, conically shaped to suit the form of the cone in the hoop, but of a slightly increased diameter, is introduced, the smaller end of the mandrel being able to enter the larger end of the hoop. The mandrel is then forced in by the hammer until its lower edge has passed through the hoop. The blows are then made to operate on the upper edge, detaching it from the mandrel. Careful measurements are taken of the diameter of the hoop before and after this test, and it is required that the measurement subsequent to the operation shall show that the hoop has partially, but not entirely, returned to the diameter that it had before the entrance of the mandrel. This would show that there is left to the metal a small margin within its elastic limit. A system of manufacture which can comply with such a refinement of exactitude must be very precise.

Perhaps the most striking feature at Le Creusot is the forge, where is assembled an array of steam-hammers not equaled in the world, viz:

One 100-ton hammer with a fall of 5 metres.
One 40-ton hammer with a fall of 3 metres.
One 15-ton hammer with a fall of 3 metres.
Two 10-ton hammers with a fall of 2½ metres.
One 8-ton hammer with a fall of 2½ metres.

As the 100-ton hammer at these works is the largest in the world, some particulars concerning it will be appropriate.

The foundations are composed of a mass of masonry laid in cement resting on bed rock, which occurs at a depth of 11 metres, an anvil block of cast iron, and a filling in of oak timber designed to diminish by its elasticity the vibrations resulting from the blows of the hammer. The masonry foundation presents a cube of 600 metres. Its upper surface is covered with a layer of oak about 1 meter in thickness, placed horizontally, on which rests the anvil block.

At the Perm foundry in Russia the anvil block for the 50-ton hammer is made in one piece, moulded and cast in the spot it was destined to occupy. Its weight is 622 tons. At Le Creusot, however, this idea was not approved, and it was determined to construct the block in six horizontal courses, each bedded upon plane surfaces. Each course is formed of two castings, except the upper one, a single block, which weighs 120 tons and supports the anvil. Thus formed in 11 pieces, it is 5.6 metres high, 33 square metres at the base, and 7 square metres at the top. Its entire weight is 720 tons. The space between the block and the sides of the masonry in which it rests is filled in solidly with oak. The block is thus independent of the frame of the superstructure.

The legs of the frame, inclining towards each other in the form of an

A, are secured at their bases to a foundation-plate imbedded in the masonry. They are hollow, of cast-iron, and of rectangular cross-section, each leg in two pieces joined midway of their length by flanges and bolts. The legs are also bound together by four plates of wrought iron, which, at the same time, hold the guides. The height of the legs is 10.25 metres and their weight, with the guides, 250 tons. The binding plates weigh together about 25 tons, and the foundation plates 90 tons.

The entablature of the frame-work weighs 30 tons; on it is placed the steam cylinder, single acting, made in two pieces, each 3 metres long, united by flanges and bolts. The diameter of the cylinder is 1.9 metres, giving a surface of 27,345 square centimetres (deducting the section of the rod, which is 36 centimetres in diameter); which, for 5 atmospheres, gives a pressure under the piston of about 140 tons. As the weight of the hammer is 100 tons, it is evident that it can be raised with great velocity.

The stroke of the piston in the cylinder is 5 metres. This height of fall, multiplied by the 100,000 kilogrammes of the mass, gives a working force of 500,000 kilogrammetres, or about 1,640 foot tons. The width between the legs is 7.5 metres, and the free height under the cross-ties 3 metres, thus providing ample space for manœuvering large masses of metal.

The entire height of this colossal structure from the base of the masonry foundation to the upper part of the steam cylinder is 31 metres (102 feet), but notwithstanding this unfavorable condition for stability and the enormous effect resulting from a shock of 500,000 kilogrammetres, everything is so well proportioned that there is but slight vibration.

The workman who manœuvers the hammer is placed on a platform on one of the legs, about 3 metres above the floor. He is here protected from the heat reflected from the mass of metal during the operation of forging.

Terre Noire.—The "Compagnie des Fonderies et Forges de Terre Noire, La Voulte et Bességės" is one of the important steel producers of France; and, though its metal has not as yet been received for tubes for large cannon, it has been largely used in the production of shells and hoops. The company claims a specialty in producing cast steel without blow-holes, which requires no subsequent working under the hammer. The mode of manufacture is known as the Terre-Noire Process, and is the result of many years of gradual development. The value of the product has been so far appreciated by the Government as to justify its use for small guns and hoops, and even for trunnion-bands, while the manufacture of steel projectiles is a large item in the yield of the works. The Terre Noire metal is produced in the Siemens furnace, and possesses in the cast state all the necessary qualities for ordinary industrial purposes; it is soft and malleable, and is said to be as strong as ordinary steel of the same grade after rolling or hammering. It is claimed that its density is always as high as, and sometimes higher than, that of ordinary forged steel. These statements are supported by facts shown in numerous experiments.

The persevering efforts of the Terre Noire Company to develop this manufacture and the expense attending years of experiment prove their confidence in the principle involved, and the encouragement given during the past two years by the Government shows an appreciation of its merit; further experience may justify the use of the metal more generally in the construction of cannon, and, if it can be made hard enough

for the purpose, it may be used for tubes. It will require exhaustive experiments to induce artillerists to accept in all cases the simply cast metal as a substitute for that forged under a hammer or press; but if a perfect demonstration shall be made of its ability to endure all tests it will open a way to a great economy in manufacture.

In general terms, as stated by Mr. Holley, the object of greatest importance in this process is to keep down oxidation in the bath from the commencement of the operation. For this purpose the furnace must be kept as hot as possible, with a good solid body of flame, but there must be only just enough air admitted to promote thorough combustion.

The process requires an initial bath of pig-iron containing from 6 to 8 per cent. of manganese. Spiegeleisen is the most convenient form for introducing it; but as a spiegel with precisely this percentage may not be at hand, the bath may be formed by taking a richer spiegel and diluting it with a proper proportion of ordinary pig containing no manganese. The greater part of the bath should be made of pig poor in carbon, particularly when highly carbonized materials are to be dissolved. The weight of the initial bath should generally be about 11 per cent. of the whole.

When the bath is completely melted the refining materials are successively added in small quantities. These are preheated and dropped at the deepest part of the hearth in front of the doors. Preheating is employed not only to keep the furnace hot, but to save oxidation. The materials used at this period of the operation are chosen with reference to the quality required in the finished product. For projectiles, the Terre Noire Company generally use Bessemer ingot and rail ends, with sinking-heads from previous projectile charges. These are all high in carbon, and contain some manganese. The proportion of refining materials to the whole charge averages 78 per cent. As soon as one charge is melted another is added, until all are fused, when a series of tests commences. The study of these specimen tests is kept up until the bath is in a condition to receive the final additions. These consist of a special pig (11 per cent. of the whole charge) containing 4½ per cent. of silicon and 3½ of manganese, and also a little ferro-manganese containing 50 or 60 per cent. of the latter. A part of these ingredients is taken up by reactions which prevent the formation of blow-holes; the remainder is left in the metal to impart to it the physical qualities required.

The special pig is charged hot. While it is melting a marked change takes place in the bath, which up to that time has bubbled about as much as in the ordinary pig and scrap operation; it becomes gradually more and more quiet, until its surface is smooth and scarcely broken by small and widely-scattered bubbles. When the special pig is nearly all melted the ferro-manganese is thrown in hot. The casting takes place immediately. The metal runs into the moulds without any splashing, and no escape of gas is noticed during the casting operation.

Spiegeleisen is used for the initial bath because the manganese it contains, being the most oxidizable of all the materials present, will remove oxygen that may be present in the bath, and will intercept oxygen that tends to enter it, so that the more manganese there is in the slag the less oxygen there will be in the metal below. By testing the slag frequently there is constantly present a delicate test of the oxidation of the bath. If this precaution were not taken, and the oxygen were allowed to go on accumulating in the bath, it would be impossible to tell how much there is of it present when the final additions of silicon and manganese are made, and how much of these substances would be re-

moved in taking up this oxygen. Therefore oxygen must be kept out, so that the whole of the ingredients finally added shall be left to perform their work.

The success that has thus far attended the development of this manufacture indicates a useful and important future for the process.

PRESENT CONDITION OF FRENCH ARTILLERY.

The artillery of the army is under the control of the director of artillery in the war department. All guns for the field and for purposes of siege and position are fabricated under instructions from this office.

The list of guns under these heads, now actually in use, comprises a large number of models and varied constructions. This is the result of the hurried manner in which, before the end of the last war, guns of all available descriptions were collected by the Government. During late years, while the re-arming of the country has been progressing, a systematic method of armament has been adopted; but this has not, up to this time, so far advanced as to justify the exclusion of the old guns from the list of those in actual use. As the number of the new guns, however, shall increase they will be substituted for the old; consequently, in presenting the present condition of the artillery of the army, the old are alluded to only in a general way.

Omitting mention, then, of the bronze smooth-bore and bronze and cast-iron rifled pieces of old date, the following may be stated as the present armament of the artillery of the army:

	Kilos.
80-millimetre (pièce de montagne), weighing	105
80-millimetre (pièce de campagne), weighing	425
90-millimetre, weighing	530
95-millimetre, weighing	710
120-millimetre (pièce de siège et position), weighing	1,200
155-millimetre (pièce de siège et position), weighing	2,527
190-millimetre (pièce de siège et position), weighing	8,000
240-millimetre, weighing	17,000
220-millimetre (steel rifled mortar).	
Revolving cannon (model of 1879), Hotchkiss.	

These guns, with the exception of the revolving cannon last named, are all constructed on the system of Colonel de Bange, late of the army. In addition to them, the army gun factories are employed in the manufacture of a large number of 24-centimetre guns which have a cast-iron body tubed and hooped with steel. They are made to assist in arming the coast. They are also much more economical than all-steel guns.

The ordnance of the navy is attached to a department in the ministry of marine, called the "Direction of Material." The bureau of the artillery of the navy is one of several bureaus under this "Direction," and is presided over by an officer, "chargé du service technique," who is virtually the chief of naval artillery. This position is filled at present by General Dard, an officer of great eminence in the marine artillery of France.

The list of guns of the marine artillery comprises a large number of calibers; and the variety in their construction shows the growth and development of the idea which has finally resulted in an armament for the navy of guns constructed entirely of steel, including the following calibers, viz: 65 and 90 millimetres, 14, 16, 19, 24, 27, 32, 34, 37, and 42 centimetres. The Hotchkiss revolving cannon also forms an important element in this armament.

Many of these guns, including some of 32 centimetres, are models of

previous years—cast-iron bodies hooped with steel; cast-iron bodies with half tubes of steel and hooped; cast-iron bodies with steel tube extending the whole length of the bore and hooped with steel—all indicating the persistent effort that has been heretofore made to utilize cast iron. The other guns mentioned above are entirely of steel.

The marine artillery is engaged in the construction of a modification of the 27-centimetre and 32-centimetre guns of model 1870, to be called the model 1870–'81. They are to be of cast iron, tubed and hooped with steel; their length will be increased to fire heavier charges than the model 1870, giving a velocity of 530 metres; eight 27-centimetre and twenty-six 32-centimetre guns of this pattern are under construction.

The 37-centimetre and 42-centimetre guns were in hand when General Dard came into his present office, and will be completed. Their weights, respectively, are 72 and 75 tons, and their construction is the same.

Eight 42-centimetre guns are in process of construction, assigned to the following turreted ships, viz: Indomptable, Requin, Terrible, Caiman.

One gun weighing 100 tons has been built by the marine artillery at Ruelle, but it is of 42-centimetre caliber, with the same sized tube as that in the 75-ton gun. It is, in fact, the 42-centimetre gun, with a body of cast iron instead of steel. Being constructed for the purpose of deciding all the ballistic particulars of the 75-ton gun, cast iron was employed for economic considerations.

The following are accepted by the bureau of marine artillery for the future armaments of the navy, and will be entirely of steel, viz:

	Length in calibers.
65-millimetre	
90-millimetre	
10-centimetre	
14-centimetre shell gun	30
16-centimetre (light), with one row of hoops	28½
16-centimetre (heavy), with two rows of hoops	28⅓
24-centimetre	28½
27-centimetre	28½
34-centimetre, 44 tons weight	18
34-centimetre, 48 tons weight	21
34-centimetre, 49 tons weight	25
34-centimetre, 52½ tons weight	28½

Material.—Although the gun factories of the army and marine artillery are engaged in the fabrication of guns with cast-iron bodies, and though Colonel de Bange advocates puddled steel for hoops, the effort to perpetuate the use of cast iron is now definitely abandoned as far as the navy is concerned, and the employment of forged cast-steel will be generally accepted.

Construction.—The army guns are fabricated on the system of Colonel de Bange. This construction requires an oil-tempered and annealed steel tube with hoops shrunk on in such numbers and in as many layers as are necessary to resist the strain brought on them by the charge. The hoops are made of puddled steel, coiled and welded. This construction is carried to the 240-millimetre gun, of which there are very few in the service.

There is a serious effort on the part of the officers of the artillery to introduce a change in the method of construction so as to have the hoops made of forged steel, and it is thought that this may result in introducing a modification so far as to have the rear hoop, in which the breech mechanism is seated, and the trunnion hoop made of forged steel, while the coiled, puddled steel will be retained for the other parts.

There are two constructions of the 34-centimetre gun of 21 calibers; one has a thick tube, with two rows of hoops; in the other, a thin tube is covered its entire length with a jacket of the same thickness as the tube, and two tiers of hoops. These guns are intended to give an initial velocity of 600 metres.

General Dard is experimenting in the direction of a larger caliber, and has under construction a gun of 37 centimetres, of the following dimensions, viz:

Diameter of bore	centimetres..	37
Diameter of chamber	millimetres..	385
Thickness of tube	do....	140
Thickness of jacket	do....	142.5
Thickness of hoops (1st row)	do....	107.5
Thickness of hoops (2d row)	do....	132.5
Total diameter	do....	1,430
Total length	do....	11,185
Length of bore	do....	10,545
Length of breech mechanism	do....	640
Weight of gun	tons..	72
Weight of tube	do....	14.7
Weight of jacket	do....	16.4
Weight of ingot for tube	do....	20

This gun is entirely of steel and the tube is in one piece. From its great length it is evident that a large charge of powder can be consumed in it, but the proposed weight of charge and projectile is not known.

The construction of the 37 and 42-centimetre guns consists of an inner tube in one piece, on the rear end of which is screwed a short tube accommodating the breech mechanism. The tube is enveloped in a jacket composed of two pieces hooked together forward of the trunnions and inclosed by two layers of hoops.

The above presents, in a condensed form, the present condition of construction in France. Particulars of most of these guns are published and can be referred to at pleasure. The only new guns to be developed are those of General Dard and Colonel de Bange, both of whom propose a 34-centimetre gun. Some particulars of the Dard gun have been given above.

The de Bange gun is made up of an interior tube and three rows of hoops, and the following are some of the particulars:

Caliber	centimetres..	34
Weight	tons..	37
Charge of powder	kilogrammes..	180
Weight of projectile	do....	450
Calculated velocity	metres..	610
Outside diameter of breech	millimetres..	940
Rows of hoops at breech	do....	3
Rows of hoops at muzzle	do....	3
Energy expected to be developed per ton of gun	metre tons..	230
Weight of carriage	tons..	
Weight of slide	do....	

The high velocity and great energy claimed are said to be due to some peculiarity of the cartridge. The novel feature, however, in the gun lies in the manner in which it is proposed to insure longitudinal strength by the grip of the hoops on the tube and on each other. The outer surface of the tube presents a series of conical undulations; the interior surface of the first row of hoops corresponds with the form of that portion of the tube which they envelop, and a similar form is carried to the exterior of the hoop, thus continuing the same adjustment of parts to the third layer, the outer surfaces of which are shaped to suit the ordinary form of a gun.

In this system each layer is made to break joint with that below and above it. The inventor is erecting a special tool of his own invention, said to be capable of such modifications as will enable it to perform all the operations of boring, turning, slotting, rifling, &c., for which in ordinary manufacture several tools are required. The developments from this experiment may prove very instructive, and will certainly be very interesting.

Breech Fermeture.—All the French guns are breech loading and are fitted with the interrupted screw system as modified by Colonel de Bange to suit his gas check.

Gas-Check.—The de Bange gas-check is universally employed, the tête-mobile of which is made of crucible steel supplied by Thomas Firth & Sons, of Sheffield, England.

Rifling.—The rifling is polygroove and parabolic in development. The number of grooves is equal to twice the caliber of gun, expressed in centimetres.

Rotating Rings.—A single rotating ring of copper is used for all calibers. Its exact position has been determined by extensive series of experiments.

Wire Construction.—The exponent of the system of wire-wrapping for cannon in France is the Schultz gun. A 34-centimetre gun made on the plan of Captain Schultz was built up as follows: A steel tube was wrapped circumferentially with steel wire and inclosed in a wrought-iron jacket; the longitudinal strain and the effort to blow out the breech was resisted by twelve longitudinal bars of steel set up at as equal a tension as possible between two bands shrunk on over the jacket, the forward carrying the trunnions and the rear inclosing the breech mechanism. The gun was made at the works of the Compagnie de Fives-Lille, under the supervision of Captain Schultz, and was sent to Gâvre to be fired. Owing to the unequal tension of the longitudinal bars the gun failed at the first fire. The cause of the failure can be thus distinctly asserted as the sound of the *successive* ruptures of the bars was recognized by those who assisted at the experiment.

Previous to its trial, and in anticipation of success, four cast-iron guns of 24 centimetres were sent to Fives-Lille to be converted on the same principle. They are tubed with steel as far as the trunnions, and are wrapped with wire. The longitudinal bars are yet to be adjusted, after which they will be subjected to trial, with but faint hopes of success, as the failure of the original gun seems to have indicated very positively the mechanical impossibility of securing an equal strain on the longitudinal bars. The contract, however, having been made for the conversion of the four guns above named, it will be carried on to its completion.

For future construction, however, the system of taking up the longitudinal effort with bars is abandoned, and the 34-centimetre gun now at Gâvre is to be returned to Fives-Lille for reconstruction. This will consist in replacing the bars with a jacket shrunk on over the wire wrappings, and which, at its forward end, will hook over the band already shrunk on the gun, and at its rear end be notched into the band containing the breech mechanism.

A gun of 10 centimetres built upon this system is now being experimented with at Gâvre, and the results have been sufficiently satisfactory to justify enlarging the chamber for the purpose of testing the gun with increased charges.

The above exhibits the present condition of this problem in France.

GERMANY.

Among the places that the Board desired to visit in Europe was included the famous establishment of Mr. Fried. Krupp, at Essen, in Westphalia; and, as in all cases where it was proposed to visit private works, a letter was addressed to Mr. Krupp, through his agent in London, requesting the necessary permission.

The permission was refused. The correspondence relating to this subject will be found in the files attached to the record of proceedings and in Appendices O, P, Q, R, S, T, U, V, of this report.

From the above statement it will be seen that the Board is unable to submit any information founded upon personal observation. For the general purposes, however, of this report the following statements will be appropriate:

With the exception of the small gun factory at Spandau, near Berlin, where a limited number of cannon up to 15 centimetres and some rifled mortars are fabricated, the source from which the armaments of Germany are supplied is the establishment of Mr. Fried. Krupp. The Government has no control over the works, consequently the principal dependence is on this private company. Owing to the great enterprise exhibited in the management, and to the support of the Government, the establishment has, for many years, enjoyed a monopoly of the manufacture of cannon for Germany, and it has been enabled to furnish guns to many other powers, notably to Russia.

As to the condition of the steel manufacture as relates to cannon, it is known that it was the practice to cast gun ingots exclusively of steel prepared in crucibles; ingots of the weight of 80 tons have been cast from crucibles more than 12 years ago. The Board is not able to state whether gun ingots are now cast exclusively from crucibles or whether they are now made from open-hearth furnaces.

The following is the present condition of the German artillery, taken from official sources:

	Calibers.
8-centimetre pivot-cannon	
8.4-centimetre field-gun	25.6
8.7-centimetre	50
10.5-centimetre	
10.5-centimetre	35
10.7-centimetre pivot-cannon	
12-centimetre, navy and coast, light	25
12-centimetre	30
15-centimetre pivot-cannon	
15-centimetre siege-gun	
15 centimetre, navy and coast	25
15-centimetre	30
15-centimetre, navy and coast	35
21-centimetre	30
21-centimetre mortar	
24-centimetre, 19 tons	
24-centimetre, 21 tons	
26-centimetre	
28-centimetre	
30.5-centimetre, light, 32 tons	
30.5-centimetre, heavy	
30.5-centimetre, 43 tons	
30.5-centimetre, navy and coast, 48 tons	
35.5-centimetre, 51 tons	
35.5-centimetre, 68 tons	
35.5-centimetre, 76 tons	
40-centimetre, 72 tons	
40-centimetre, 97 tons	
40-centimetre, 109 tons	

The power of the Krupp gun is best illustrated by the reports of firings that took place at Meppen in 1879 and subsequently. These reports are available for reference.

The material used in the construction of the Krupp guns is steel.

The system of construction is that of a built-up gun, with tube and hoops. In the larger guns of latest design the first hoop shrunk on the rear of the tube is lengthened, resembling the jacket of the Vavasseur design.

The fermeture is the cylindro-prismatic wedge, modified from the original invention of Mr. Broadwell, and adopted by Mr. Krupp. The gas-check is also the invention of Mr. Broadwell and bears his name.

The Board can give no information upon the subject of wire-construction in Germany.

The essential point to be observed in this short notice is that the main supply of the artillery of Germany is drawn from one private firm. In this respect the method differs from that followed either in England or in France. It goes without saying that the Government pays a high price for the manufactured article.

RUSSIA.

SOURCES FROM WHICH THE ARMAMENT OF RUSSIA IS SUPPLIED.

The Government of Russia has been an extensive purchaser of cannon from Mr. Krupp, at Essen; but, after adopting the Krupp gun for its armament, it proceeded to manufacture on that system for its own uses.

The course pursued to produce a supply from home manufacture was that of joint action between the Government and a private firm. The large steel works of Aboukhoff, near St. Petersburg, was the establishment with which the Government entered into partnership, becoming the owner of one-third of the stock. The Government is represented in the board of directors, the works are in the hands of the Minister of Marine and Admiral Kolokoltzoff is the chief administrator or superintendent. At the commencement of the joint action, the Government contributed largely to increase the plant by providing tools suitable for its work, and very substantial aid has been provided from time to time.

The substance of this statement was collected from parties with whom intercourse was held, who did not, in distinct words, condemn the practice under which the Government has been acting since it commenced to manufacture its own guns, but they evidently held the idea that the condition of affairs would be much improved if the Government had absolute control of the works. In order to achieve this object it was understood that the Government is soon to acquire such additional stock as will make it owner of about two-thirds of the whole. When this shall be accomplished it is thought that the Government will be able to produce its guns at less expense than is now incurred.

It was freely admitted that the material produced under this system of joint action has been at great cost, but the Government has reconciled itself by the conviction that the product was of first-class quality and better than could be procured from other sources at less expense. The ground is taken that, in a matter so important as armament, high price is not to be considered an obstacle to the possession of the best guns

that can be produced, and the authorities believe they have attained this object in their manufacture.

This experience of the Russian Government in its joint action with the Aboukhoff Steel Works bears directly upon one of the most important points that the Board is required to consider, viz, "any other method" apart from a Government foundry, pure and simple, by which cannon can be provided; and the results above cited demonstrate that in this combination in Russia, as in that between the English Government and the Elswick Ordnance Company, the Government must always expect to bear the loss.

The acquisition of additional stock may give the Government such control in the direction of the business of the works as to smooth the way to its possession of the whole. This seems to be the natural conclusion of the process now in operation, and its consummation would be a declaration of the practical failure of the plan inaugurated at the commencement. The experience of joint action between the Government and a private firm in Russia does not encourage the experiment in our own country.

Nearly the entire production of steel for cannon is distributed between the Aboukhoff Steel Works and the Kama, near Perm (in the Ural Mountains), but the product of the former is the more considerable. Among others, the Iznoskof and Alexandroff private steel works (both near St. Petersburg) manufacture projectiles, and as the Government diminishes its contracts abroad they will develop their plants to meet the demands for gun material.

Russian Artillery-Gun Factory.—Although the amount of field artillery and siege pieces in the possession of the Government is very large the work of manufacture is actively progressing, and the Russian Artillery-Gun Factory in St. Petersburg is constantly occupied in the construction of guns up to and including the 8-inch and rifled mortars of 9-inch caliber. This factory is well supplied with tools, has a capacity to turn out 70 field guns per month and is rapidly replacing the older models on hand; but its plant is not equal to all the work demanded of it. The deficiencies are supplemented by the Aboukhoff Works.

Aboukhoff Works.—The Aboukhoff Works, which include the manufacture of steel on a large scale and the fabrication of cannon of all calibers, both for the army and the navy, are situated in the alluvial basin of the Neva River, where good foundations are to be had only at great expense. The excavation for the 50-ton hammer was carried down 50 feet before moderately hard bottom (gravel) was reached. This cause has added largely to the general cost of construction of the works.

The shops are extensive and numerous, but as they have been erected as needed, without regard to any general plan, they furnish no guide for constructing a new establishment. The largest gun shop is 700 feet long and 70 feet wide, with the tools disposed longitudinally. The severity of the climate has rendered it necessary to seal overhead with wood, and from this cause the shop is not so well lighted as is usual in Europe. The plant is of good quality and is being extensively developed. In the foundry advantage has been taken of the undulations of the ground to place the forge at a lower level than the furnaces, thus conveniently providing for the transportation of the hot ingots by railway direct from the bottom of the casting pit to the hammers. The capacity for casting reaches from 40 to 50 tons, requiring 1,200 crucibles.

CONDITION OF STEEL MANUFACTURE.

There can be no question as to the character of the ore from which the metal used for cannon in Russia is produced. The Russian mines, from which much of it is obtained, are situated in the Ural Mountains, on the border of Siberia. The ore is smelted with charcoal, and the iron is fully equal to the famed iron of Sweden. It is received at the Aboukhoff Works in the form of cast and wrought iron. Use is also made of the best Swedish and Spanish iron.

The puddled steel, which is the basis of the Russian gun-metal, is prepared at Perm and at the Aboukhoff Works. The steel for casting all gun tubes, jackets and large hoops, is prepared in crucibles. A portion of the magnetic ore, which is found in the Ural, is one of the elements introduced into the crucibles and is said to have a beneficial effect upon the mixture.

Hoops for some small guns are made of Bessemer steel, the charge being selected from the best Ural and Swedish ores. The Siemens-Martin Process is restricted to the manufacture of small ingots, being regarded with much less favor than crucible castings.

The most important improvement which has recently been introduced is Sir Joseph Whitworth's system of liquid compression. The advantages of this press have been alluded to in a former part of this report and need not be again recited. At the Aboukhoff Works, the effect of liquid compression is considered as very beneficial, and the impression was received that the system of forging by the press would also have been adopted if there had not already been established at the works one of the largest and most expensive hammers in the world, the tup of which weighs 50 tons, with a fall of 12 feet.

PRESENT CONDITION OF RUSSIAN ARTILLERY.

Russia has adopted the Krupp breech-loading system with slight modifications for all calibers, but a few guns fitted with the French interrupted screw were noted. Steel alone is used for new fabrications.

The heavy ordnance for naval and sea-coast defense is designed to give velocities from 1,700 to 1,800 feet; but experiments to gain an increase, by lengthening the bore, are in progress. The following are the principal calibers:

12 inch 40-ton guns, 20 calibers long, are adapted for arming the "Peter the Great" and the "Popoff"—one, 30 calibers in length, weighing 50 tons, and burning 390 pounds of powder, is now under trial.

11-inch 27-ton guns, 22 calibers long, are used in several turret ships and in sea-coast batteries. The tube requires a 30-ton ingot.

There are also many naval 9-inch, 8-inch, and 6-inch guns about 22 calibers long, in service; but the models will soon be modified by increasing the length. For land fortresses the 6-inch gun is the prevailing type. Most siege guns on hand are of bronze, but a new steel pattern will be adopted for future fabrication.

A recent accident gave a severe test to the system of construction adopted for Russian artillery. In experimenting with gun-cotton for use in shells, one of the latter, containing 40 pounds, exploded in the chamber of an 11-inch gun when the charge of gunpowder (128 pounds) was fired. The rear part of the breech was blown off at the weak point of the Krupp system. The trunnion band was broken, throwing off a fragment; and *the diameter of the chamber was enlarged* 1 *inch*. The

admirable quality of the metal, and the good adjustment of the strength of the several parts is evident from this statement.

In testing steel no value is attached to the ultimate breaking stress or percentage of elongation; and the computations are all based on the elastic limit which is determined by noting where the increasing stresses and elongations cease to be proportional. This must never occur below 2,400 atmospheres (16 tons per square inch).

Construction.—All field guns are of steel, and are mounted on a carriage fitted with rubber buffers to reduce the shock.

The special novelty of the Russian ordnance is a thin steel lining tube, designed to receive the wear in firing and to be renewed when needful, without the expense and difficulty of re-tubing. This system is adopted for all calibers from the smallest up to the 12-inch gun, inclusive. The operation of inserting one of these lining tubes in a field gun was witnessed at Aboukhoff. The difference of their diameters was very small. The fitting of the slightly conical surfaces by measurement before insertion was done with precision.

When ready for insertion the lining tube was lubricated and introduced by hand. It was forced by hand levers until the end was nearly flush with the breech; hydraulic power then applied by a hand-pump was gradually increased to a pressure of 180 atmospheres, although no motion was apparent after it had reached 100 atmospheres. The rear end of the lining tube forms the recess for the Broadwell ring.

The Russian officers claim that these tubes can be renewed in the field, and cited instances of two 9-inch mortars, weighing 5½ tons each, needed for use on the Danube during the late war. Being too heavy for the available means of transportation they were forwarded in three pieces—a tube, a breech-jacket, and a muzzle-jacket. The two latter were screwed together, and the tube was inserted by a jack on the spot; both mortars did excellant service.

Sheets of recent unpublished experiments were exhibited, showing the locus of the varying pressure in the bore of a long 4.2-inch gun. These pressures were measured by Rodman gauges in the usual way, special care being taken to place the part acted upon by the gas nearly flush with the bore. The results thus far have proved quite accordant ı very interesting, indicating that as the distance from the bottom of ı bore increases the pressures at first decrease a little, and then rapiuıy increase to a maximum at a point slightly in rear of that originally occupied by the front band of the projectile. Here the pressure is nearly double that at the bottom of the bore, and evidently is increased by the reaction from the shot at the instant of taking the grooves. This investigation has much importance in connection with the problem of the best form and dimensions for the powder chamber. The experiments are to be continued with a 16-inch 80-ton steel gun made at Aboukhoff and fitted for this purpose. It is 22 calibers long and constructed in the following manner, viz: tube in one piece; jacket in three parts extend to muzzle; four layers of hoops and a fifth hoop over the breech. Iı pierced at various points to receive the gauges.

An experimental 11-inch 47-ton all-steel gun, 35 calibers long, consisting of tube, jacket in two parts extending to muzzle, and three layers of tapering hoops, was ready for trial.

Rotating Rings.—Projectiles are fitted with two copper bands, the front one to give a uniform bearing and the rear to take the rifling. Both are made of rods hammered into place by hand, because this is supposed to give a better hold than can be had by machinery.

The experiments with Russian artillery are made at the Polygon at

Ochta, near St. Petersburg. The grounds afford a range of about 7 miles, and the establishment of the navy under Admiral Kouprianoff, and of the army, under General Erme, are side by side, so that each service can always witness what is done by the other. A 12-inch 50-ton rifle, an 11-inch and several smaller guns were in position at our visit.

THE UNITED STATES.

SOURCES FROM WHICH THE ARMAMENT OF THE UNITED STATES IS SUPPLIED.

Previous to and during the civil war the armaments of the United States were supplied from—

The Cold Spring Foundry, West Point, N. Y.
The South Boston Iron Works, Boston, Mass.
The Fort Pitt Foundry, Pittsburgh, Pa.
The Reading Iron Works, Reading, Pa.
The Builders' Iron Foundry, Providence, R. I.
The Phœnix Iron Company, Phœnixville, Pa.
The Ames Manufacturing Company, Chicopee, Mass.

Since the termination of the war the Fort Pitt Foundry has ceased to exist. The South Boston Iron Works Company has manufactured a few experimental guns, and with the West Point Foundry has executed some small orders of the Government in the conversion of cast iron smooth-bores into rifle guns by inserting and rifling a coiled wrought-iron tube.

None of the companies mentioned above have ever made steel guns, and virtually the United States is destitute of a source from which such an armament as the age demands can be supplied.

CONDITION OF STEEL MANUFACTURE.

With a view to such experiments as their appropriations would justify, the Ordnance Bureaus of the War and Navy Departments have from time to time addressed the steel manufacturers of the country on the subject of furnishing steel for cannon, but thus far have met with only a partial success.

The reasons for this will be noticed farther on in this report, but the fact is here stated to emphasize the conclusion that the immense steel works of the United States, from lack of demand for this special material, have not the necessary plant for forging, and are in no condition at present to manufacture steel for cannon in such quantities and in such sizes as are essential for a suitable armament for the country.

PRESENT CONDITION OF THE ARTILLERY OF THE UNITED STATES.

To recite under this heading the present armament of the country is unnecessary. Before the introduction of rifled cannon and the use of steel as the material for their construction, the United States boasted of her Dahlgren and Rodman cast-iron guns, which were the models for imitation and the standards for comparison of all nations.

While the rest of the world has advanced with the progress of the age, the artillery of the United States has made no step forwards. Its present condition of inferiority is only the natural result of such want of action.

COST OF PLANT FOR THE MANUFACTURE OF GUNS.

From information gained in its investigations and from consultation with the managers of those large establishments abroad where gun tools are made, the Board submits the following estimates.

As it will recommend that "for the manufacture of heavy ordnance adapted to modern warfare," the steel should be produced by private companies and the guns fabricated in Government shops, these estimates will be made under three heads, viz:

Machines and tools for steel plant.
Machines and tools for gun factory.
Buildings.

MACHINES AND TOOLS FOR STEEL PLANT.

On the matter of plant for casting and forging the Board obtained information chiefly from Sir Joseph Whitworth & Co., of Manchester, and from Messrs. Tannett, Walker & Co., of Leeds, England.

The following is an approximate cost of plant for casting and forging ingots up to 100 tons, submitted by Tannett, Walker & Co.:

Sixteen groups (4 each) gas producers.
Ten 12-ton Siemens furnaces.
Two large reheating furnaces.
Five 24-ton hydraulic center-casting cranes.
Six 5-ton ingot cranes.
Two 170-ton and two 30-ton power traveling cranes, 50 feet span, with engines.
Two 24 feet by 19 feet hydraulic accummulators.
Two pairs pumping engines; either 18 inches by 24 inches (single), or 15 inches by 28 inches by 24 inches (compound).
One overhead tank.
Pipes for above hydraulic cranes.
One 3,000-ton hydraulic press.
One pair pumping engines for working press.
Total cost, exclusive of buildings, about $300,000.

This estimate does not include tools for rough boring or turning, nor appliances for tempering.

The additional cost of these tools and appliances should be added as forming part of the expenses properly belonging to the foundry. As will appear hereafter, the cost of a complete plant for rough boring and turning, including all guns up to 100 tons, will be about $210,000; the tempering pit, furnaces, &c., will cost about $50,000; which, exclusive of buildings, would, upon the estimate of Tannett, Walker & Co., make the total cost of a plant capable of casting, forging, rough-boring, rough turning and tempering the parts of guns up to 100 tons, about $560,000.

The following is an estimate from another source, for a 100-ton ingot steel plant, confined exclusively to the process of casting:

Eight 15-ton Siemens furnaces, with platform and producers complete.
Two ordinary travelers for ingot-pit.
Eight 15-ton ladles.
Railway metal and laying.
Hydraulic cranes.
Cost, exclusive of buildings, about $215,000.

The following is an approximate price of a plant for casting and forging 72-ton ingots:

Ten groups (4 each) gas producers.
Six 12-ton Siemens furnaces.
Two large reheating furnaces.
Three 24-ton hydraulic center-casting cranes.

Pipes for hydraulic cranes.
Four 5-ton ingot cranes.
Two 100-ton and two 30-ton power traveling cranes, 50 feet span, with engines.
Two 18 feet by 19 feet hydraulic accumulators.
Two pairs pumping engines, either 18 inches by 24 inches (single), or 15 inches by 28 inches by 24 inches (compound).
One overhead tank.
One 3,000-ton hydraulic press.
One pair pumping engines for working press.
Cost, exclusive of buildings, about $205,000.

The following is an estimate submitted by Sir Joseph Whitworth for a plant for casting 60-ton ingots:

Three 20-ton melting furnaces, including all steel and iron work, all silica and fire-bricks, valves, levers, stages, ladles, apparatus for making clay used in the moulds and ladles, the iron work and all fire-bricks for gas producers, a competent man to superintend erection, but exclusive of all common bricks, brick-setting, excavating, &c., $70,000.

This plant, if supplied with a sufficient number of re-heating furnaces and kept in full work, would be capable of turning out 150 to 200 tons of large-gun material per week.

The following are estimates submitted by Sir Joseph Whitworth for forging presses:

A 34-inch hydraulic forging press complete with its engines, pumps, boilers, two hydraulic traveling cranes, two re-heating furnaces with hydraulic apparatus for raising the doors. An assortment of steel chucks, mandrels, draw-bars, porter-bars, swage and other blocks for enlarging and reducing hoops, &c., apparatus for withdrawing mandrels, &c., $200,000.

A 24-inch hydraulic forging press, complete in all details, as in the case of the large one already cited, will cost about $140,000.

The forging press, though not a new idea, has been but little used; in fact, to this time, it has been adopted in but one large establishment in the world; consequently its manufacture is costly. Its general adoption is now a matter of certainty, and its cost will no doubt be reduced; hence, it is probable that a 36-inch forging press with cranes, engines, pumps, accumulators, &c., exclusive of buildings, may be obtained for $150,000.

If the system of liquid compression should be adopted, the additional cost of a hydraulic casting press, complete, including steel mould boxes, overhead hydraulic traveling cranes to lift 100 tons, including columns and girders, and complete in every respect, except masonry and brick-work, would be $175,000.

The following is an estimate of the cost of tools for rough boring and turning the parts of guns for all calibers up to 16 inches:

One rough-turning lathe for tubes and jackets up to 12-inch caliber.
Three rough-boring lathes for same.
One rough-turning lathe for tubes and jackets up to 16-inch caliber.
Two rough-boring lathes for same.
One 100-ton power traveling crane.
One 20-ton power traveling crane.

Tools for the above, including:

Assorted tools for rough-turning lathes.
Forged cast-steel boring bars with head and steel cutters for boring tubes out of the solid.
Forged cast-steel bars for boring jackets.
Sets of tools for each of the hoop and trunnion lathes, and for the slotting machines.
The total cost will be about $210,000.

If a complete set of trepanning tools were to be furnished for the work of rough boring, the additional cost will be about $50,000. The first cost of these tools is very great, as they are made from very large

ingots of cast steel, oil tempered, which have to be bored and turned almost entirely away.

The above estimates respond to the call of the act of Congress so far as relates to cost of a steel plant for the manufacture of the heaviest guns, and will answer some of the inquiries of, and serve as a guide for, those of our steel manufacturers who shall undertake to supply the Government with the required material for modern artillery.

As the greater includes the less, it may be taken for granted that no plant for smaller work can equal the above estimates. The scale of diminution in proportion to the weight of metal and capacity of cranes, presses, &c., may be approximated, and the following list of weight of forgings required for different calibers in the English service will assist the calculation:

Particulars of forgings for English gun tubes.

Weight and caliber of gun.	Weight of ingot cast.	Weight of forging for tube.	Model.
110 tons	About 100 tons	70 tons	New.
100 tons, 17 inches	Breech part, 27 tons Muzzle part, 15 tons	21 tons, 2 cwt 12 tons, 11½ cwt	Old.
80 tons, 16 inches	21 tons	17 tons, 7 cwt	Old.
63 tons, 13.5 inches	35 tons	27 tons, 17 cwt	New.
43 tons, 12 inches	27 tons	21 tons	New.
26 tons, 10.2 inches	14 tons	11 tons, 10 cwt	New.
18 tons, 9.2 inches	12¾ tons	10 tons, 5 cwt	New.
11½ tons, 8 inches	10¾ tons	8 tons	New.
80 cwt., 6 inches	4½ tons	3 tons, 12¾ cwt	
38 cwt., 50-pounder	2¾ tons	1 ton, 18¾ cwt	
32 cwt., 4-pounder	1½ tons	1 ton, 2½ cwt	

The forging for the 100-ton gun cited above is that which was supplied for the Armstrong gun furnished the Italian Government, the tube for which was made in two parts. That for the 110-ton gun now to be made for the English Government will be in one forging.

If the cost per ton be fixed for the smaller guns, and an increasing ratio be established per ton as the caliber increases, the approximate cost of the forgings for guns of like pattern can be determined.

From an inspection of the table given above it will be seen that it is within the resources of many of our own steel works to supply castings for a large number of the different calibers. These works, however, are deficient in forging apparatus.

In the above estimates the cost of a steam hammer is not given, as the Board unanimously approves the adoption of the press; but it will be pertinent to add that, in order to produce a given amount of work, the hammer is the more expensive tool.

MACHINES AND TOOLS FOR GUN FACTORY.

On the matter of plant for gun factory the Board obtained information from the principal gun factories of England, France, and Russia, where machines and tools are in operation, and from the largest establishments where such tools are made, but chiefly from Messrs. Greenwood & Batley, of Leeds, Mr. Hulze & Co., of Manchester, and Messrs. Varrell, Elwell & Middleton, of Paris.

In considering this part of the subject it was decided that there were three classes into which guns could be advantageously divided in reference to tools suitable for their fabrication, viz:

(I.) Guns of 6-inch and all below that caliber.

(II.) Guns from 6-inch to 12-inch caliber.

(III.) Guns of caliber greater than 12 inches.

It was necessary to adopt a tool as a unit on which to base the calcu- ion that should determine the number of tools required under the ve classes. The rifling machine was the unit adopted. The object to so proportion the numbers of each tool as to keep the rifling ma- constantly employed.

the solution of this problem the Board has had the advantage of able assistance of the firm of Greenwood & Bat ey, of Leeds, Eng- l, whose tools were seen in all the large gun factories visited in ope. They have spent much time and incurred much expense in providing plans and estimates, and have communicated most valuable confidential information. The following estimates, stated in a general way, are the results, and the Board is confident of the essential accuracy.

(I.) Cost of Gun Factory Plant up to 6-inch Caliber.

This plant does not include rough boring and turning lathes for tubes jackets, and hoops; these parts are supposed to be supplied ready for finishing. It includes:

Two finish turning lathes.
Three finish boring lathes.
One lathe to chamber, cut breech-screws, &c.
One rifling machine.
One milling and drilling machine.
One 10-ton power traveling crane.
Tools for above, including—
A set of turning tools for each finish turning lathe.
One boring bar with head and cast-steel tools for boring lathes.
One chambering bar with cutting tools.
One steel bar and cutting tools for screw-cutting and shaping out spaces.
One hollow rifling bar with cutter, adjustment, and cutting tools.
Milling cutters and mortise drills for milling and drilling machines.
The total cost will be about $50,000.

This plant is capable of producing one 6-inch gun per week, or a proportionally larger number of smaller calibers.

(II.) Cost of Gun Factory Plant up to 12-inch Caliber.

This plant does not include rough boring and turning; the parts are supposed to be supplied ready for finishing. It includes:

One finish turning lathe.
Three finish boring, turning, and chambering lathes.
One machine to cut breech-screw, &c.
One rifling machine.
One milling and drilling machine.
Four combined boring and turning face lathes for hoops.
One combined boring and turning face lathe for trunnion hoops.
One combined boring and turning lathe for trunnions.
One slotting machine for trunnion hoops.
One 40-ton power traveling crane.
Tools for the above, including—
Cast-iron tubes with steel head and cutter for finish boring tubes.
Cast-iron tube with steel head and cutters for finish boring jackets.
One chambering bar.
Fifty assorted turning tools for finish turning lathes and machine for cutting breech screw and spaces.
Cast-iron hollow rifling bar with cutter head, adjustments, steel tube for actuating tool, and cutting tools.
Four milling cutters and mortise drills for milling and drilling machine.
The total cost will be about $150,000.

This plant is capable of producing one 12-inch gun every three weeks, or a proportionally larger number of smaller calibers.

(III.) COST OF GUN FACTORY PLANT UP TO 16-INCH CALIBER.

This plant does not include rough boring and turning; the parts are supposed to be supplied ready for finishing. It includes:

Two finish turning lathes.
Three finish boring, turning, and chambering lathes.
One machine to cut breech-screw, &c.
One rifling machine.
One milling and drilling machine.
Four combined boring and turning face lathes for hoops.
Four combined boring and turning face lathes for trunnion hoops.
One combined boring and and turning lathe for trunnions.
One slotting machine for trunnion hoops.
One 100-ton power traveling crane.
Tools for the above, including—
Two cast-iron tubes with steel boring head and cutters for finish boring tubes.
One cast-iron tube with steel boring head and cutters for finish boring jackets.
One steel chambering bar.
Fifty assorted turning tools for finish turning lathes and machine for cutting breech-screw and spaces.
One cast-iron hollow rifling bar with cutter head, adjustments, steel tube for actuating tool, and cutting tools.
Four milling cutters and mortise drills for the milling and drilling machines.
The total cost will be about $350,000.

This plant will produce one 16-inch gun per month, or a proportionally larger number of smaller calibers. In the room allotted to shrinking on the jackets and hoops there will be required an additional traveling crane capable of handling guns of the heavest weight, which will cost about $17,500.

From these estimates, the cost of equipping a gun factory capable of producing guns from the lowest caliber up to 16 inches will be about $570,000.

If the tools mentioned above are to be made in the United States, these estimates would have to be largely increased, because there has been no demand to especially direct the attention of our manufacturers to them; from this want of experience great delay and expense would result in the preparation of plans, specifications, and patterns.

A wise policy would seem to demand that the tools required in this first plant should be purchased from those parties abroad who have had the most valuable experience in their manufacture.

Buildings.—At most of the establishments visited by the Board, the buildings have been constructed successively to meet increasing demands for space; and they therefore do not exhibit that systematic study which naturally would be demanded in planning a new gun factory. In such a problem the first step would be to decide upon the tools to be ordered, and their most convenient arrangement, and then the architect would be able to design the most suitable buildings.

As the Board will recommend that the manufacture of the metal and the fabrication of the guns shall be separately considered, and that the work shall be done at different localities, it has regarded the proposition of detailed plans for the buildings as inexpedient, not only because there would be little probability of their final adoption, but also because the time required for the estimates would materially delay the completion of the report. The subject, therefore, will be treated in a general manner. The following are the most important points developed by experience in Europe:

1st. Substantial foundations.

2d. Strong but economical superstructures, secure against destruction by fire.

3d. Carefully considered lighting arrangements.

4th. Dimensions suited to the most convenient use of the tools, but which avoid waste space under cover.

Two distinct arrangements are in use abroad. In one, best illustrated by the new shops of Sir Joseph Whitworth, at Manchester (intended for general work), all the operations are performed under a single roof, a plan which has the merit of bringing all the workmen under the eye of the superintendent. The building has ten bays, each 50 feet wide, and at present 575 feet long, but it is proposed to extend this length 200 feet. Six bays are devoted to the foundry proper where the steel is manufactured and forged, and the remaining four to the tools used in fabricating the finished products. A gallery 25 feet wide extends along one side of the building, forming a second story, where small tools are made. Overhead cranes are provided, where necessary, to run the whole length of a bay, and the larger machines are disposed longitudinally under them. The height of the run-ways of these cranes is 22½ feet above the floor. Each bay is covered by a roof of 50 feet span and 18 feet rise. These roofs unite in valleys 8½ feet above the run-ways, to afford room for the cranes; and light is supplied by continuous windows, which on the south side form the middle third, and on the north side the lower two-thirds of the roofs. The outer walls are brick. The bays are separated by rows of cast-iron columns capped with wrought-iron trusses, on which rest the iron roofs.

These magnificent shops, constructed very recently, after Sir Joseph's long experience in such work, cost per running 50 feet of each bay:

Iron work of supports	$1,250
Roof plating, glazing, glass, lead, &c	2,000
Floors, plates, &c	1,190
Contingencies	560
Total per square 50 feet, about	5,000

Estimated upon this basis, given by one of the engineers, the total cost must have been at least $600,000.

In the other general arrangement of shops which prevailed at most of the establishments visited, different buildings are provided for different classes of work, with ample space between them for railway tracks, storage of metal, &c. Experience seems to have suggested the importance of the following points:

The run-ways of the large cranes should be supported quite independently of the buildings. As their spans vary from 40 to 64 feet, generally about 50 feet, this is an important matter. There is no economy in constructing the walls to bear strains thrown upon them by powerful machinery. The true function of the building is simply to cover the tools against the weather.

The problem of reducing the cost of roof trusses is an important one. For smaller machines, an economical and convenient arrangement was noted at the army establishment at Bourges. The building was about 260 feet long and 150 feet wide. Advantage was taken of the lesser height required for this class of work to dispense with roof trusses entirely. Cast-iron columns, about 17 or 18 feet apart, divided the whole interior into squares and furnished supports for the roof at so many points as to effect this object. The tools were disposed across the shop, and hand cranes overhead and medial railway tracks for cars supplied every facility for convenient handling. For the larger tools, however, the spans are necessarily so great that it seems expedient to increase their width so as to dispose the machines across the bays. This

enables the arrangement to be very compact, and enough is saved in length of shop to compensate for wide trusses. Thus, in the two new shops at Ruelle, which are good models, the spans of the principal roof trusses are about 50 feet and 82 feet respectively, the total width of the buildings being extended by parallel and lower roofs to 98 feet and 130 feet.

Roof-lighting of gun-shops is general throughout Europe. Sometimes, as in Sir Joseph Whitworth's establishment, the ridge-pole is placed centrally between bearings, and one-third of the south and two-thirds of the north surface is glazed. At other places, as at the shop at Bourges just described, the ridge-pole is nearer the north side, and the short and steep side of the roof only is glazed. Another plan is the common device of a ventilator cap over the ridge-pole, with vertical lighting. As a rule all available space at the sides and ends of the buildings are given up to windows. No gun-shops of more than one story were noted.

The Board would recommend the erection of fire-proof structures of a single story, designed solely to cover and protect the tools. Their style of architecture should be neat, but not extravagant; convenience of arrangements and facilities for lighting should receive careful study. It is believed that the cost of such buildings as are required can be safely estimated at $5,000 per square of 50 feet.

GENERAL SUMMARY.

The foregoing presents the chief points of information that have been gained by the investigations of the Board.

As examples of a practical partnership between a Government and a private company in working towards a national object the experiences in England and in Russia are very instructive, and warn against the adoption of such a system. In England, the Government, in addition to paying, during several years, very high prices for articles delivered, was forced to pay £65,000 to close an agreement; while the company, besides the profits on manufacture, came into possession of a complete working plant at a mere nominal valuation.

In Russia the Government finds itself involved with a stock company, paying excessive prices for what it receives, and discovers no way of relief except by buying up shares and operating the establishment as a Government foundry.

As an example of depending almost entirely on private works Germany is a perfect instance. The works of Mr. Krupp are practically the sole source of supply of the German artillery. In such a case the Government must be the slave of the corporation, and subject to its whims, caprices, and conveniences. It needs no argument to show the dependent condition of the Government under such a rule; it might prove a source of the greatest embarrassment. The Board is well informed that some ten or eleven years ago the artillery officers were very restive under this load, and were making strenuous efforts to be relieved from it, but without success. It is hardly to be supposed that time has quieted the feeling of dissatisfaction.

As an example of depending alone on Government works France was a perfect instance before the Franco-German war. During the period referred to the Government foundries were the sole source of supply of the armament of the country; the officers charged with the work formed a close corporation; their action was never exposed to the public; their ideas were

never subjected to criticism; the ingenuity and inventive talent of the country were ignored and resisted, and no precaution was thought necessary to provide a supply in case of need of re-armament. The result is well known; a great crisis came; the Government works were inadequate to meet the additional demands made upon them, and the patriotic efforts of private establishments were inadequate to produce all the material that was needed. How entirely France has now altered her system is shown in a previous part of this report; her present practice is theoretically perfect, and it has proved to be practically efficient. Her Government establishments are still retained, but as gun *factories* simply, in which the parts are machined and assembled, but for *foundry* work she depends upon the private industries of the country, and many of these works have found it to their profit to establish gun factories which supplement the Government factories to a great extent.

The conclusions of the Board on this subject accord with the plain teachings of these historical instances. It accepts the system now pursued in France as the proper standard for imitation, and recommends that in inaugurating the manufacture of war material in our own country a conformity as close as circumstances will admit to the plans which have proved so successful in France should be observed.

Having reached this conclusion, the Board is now prepared to dispose of the propositions into which, as stated on the seventh page of this report, the second interrogatory in the act of Congress was divided. The first proposition was thus presented, viz:

That the Government should supplement the plants of some of the steel workers of the country with such additional tools and implements as would enable them to turn out finished steel cannon.

The adoption of this proposition would involve the Government in the embarrassments which now exist in Russia, and which we have seen were so costly to the English Government in its partnership with the Elswick Ordnance Company.

The Board does not approve of such joint action.

The second proposition was thus presented, viz:

That the Government should give contracts of sufficient magnitude to enable the steel workers of the country to supply the finished guns without its direct aid.

This proposition, if adopted without any qualification, would make the Government dependent entirely upon the private industries of the country, which might combine to the detriment of the public service. The Government would have no guard against extortion and would be powerless against a combination. An actual instance of such a combination is cited in a previous portion of this report as having taken place in France, but the independent position of the Government made the effort futile.

The Board does not approve of this proposition taken by itself.

The third proposition was thus presented, viz:

That the Government should establish on its own territory a plant for the fabrication of cannon, and should contract with private parties to such amounts as would enable them to supply from the private industries of the country the forged and tempered material.

This proposition is approved by the Board and is regarded as the foundation upon which our system of manufacture should be built up. If this be done, and the Government made secure by the possession of works of its own, there is every reason to adopt in addition the idea embodied in the second proposition in order to *supplement* the Government establishments.

A state, with any pretensions to military power, should provide itself with factory facilities on a sufficient scale to perform the work of establishing standards, making experimental guns and fabricating cannon on a moderate scale; but it is not considered judicious to concentrate in the Government establishments all the work of fabrication or to include within their operations the preparation of such material as can be provided by the private industries of the country. In the case under consideration the purchase of the steel required for cannon will stimulate our own manufacturers and interest them in the operations of the Government.

The Board is thus led to the conclusion that it is not advisable to embark in the establishment of a gun *foundry*, properly so called, but that it is more judicious to establish gun *factories*, and to purchase the material from our manufacturers.

At present the steel manufacturers of our country are not prepared to produce the material required for the larger calibers, and the important question arises, what means shall be adopted to induce them to study the subject and embark in the manufacture on a large scale. They cannot be expected to do this at a sacrifice of their own interests. This object can only be achieved by holding out a fair prospect of ultimate remuneration for the expenditures necessary to undertake the work, and this can only be done by the action of Congress.

If, then, Congress, shall conclude to arm the country it will be necessary that a sum of money shall be fixed as a permanent yearly appropriation to be expended for this purpose, the amount to be assigned proportionally between the War and Navy Departments. With such a guarantee against loss the Board is satisfied that the required material for cannon will be forthcoming from our own steel works.

It would not be necessary for the Government to be associated with a large number of firms for the supply of its material, for it is probable that the private establishments that would take up the subject would only be those with large available funds which they would be willing to put into a special plant, and for remuneration on which they would be willing to wait a reasonable time. The permanent appropriation would give them surety of ultimate profit, the only condition being success in providing the material that would be indicated in their contracts. From personal intercourse with some of the leading manufacturers the Board is led to believe that the plan will have the effect of guiding the private industries of the country to the aid of the Government in developing this work of national importance.*

It may be added that although the manufacture of armor plates for ships and fortifications was not referred to this Board for investigation, the erection of plant for providing modern cannon would go far towards reducing the outlay requisite to enable our great steel manufacturers to meet another pressing want of the Government.

The chief expense to be considered by private parties is that of the *forge*, but by the substitution of the hydraulic press for the hammer economy will be consulted and better results obtained. The Board is unanimous in approving the use of the press for all forging purposes; and recommends it to all who may embark in the manufacture of gun metal for the Government.

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* This conclusion is fully sustained by letters, Appendices H, J, and by a communication received from the Cambria Iron Company on February 8, 1884, after the completion of this report. It is marked Appendix N.

In conclusion the Board submits its replies to the three interrogatories contained in the act of Congress:

(1.) Which of the navy-yards or arsenals owned by the Government has the best location, and is best adapted for the establishment of a Government foundry?

The Board does not recommend the establishment of a Government foundry, properly so called, which shall provide for the manufacture of steel and the fabrication of cannon. It considers that every inducement should be offered to attract the private industries of the country to the aid of the Government in providing ordnance for the Army and Navy, and that the steel manufacturers should be called upon to provide the material.

The Board recommends the establishment of two gun factories under the control of the Government and selects the—

Watervliet Arsenal, West Troy, N. Y., as the site for the Army, and the *Washington navy yard, District of Columbia, as the site for the Navy.*

The Board is unanimous in recommending that the Army and the Navy should be provided with separate establishments. This has always been the custom in France, producing good results; the reverse has been the practice in England, producing bad results. Dissatisfaction from this cause has existed for many years in the English Navy, and the Admiralty has recently brought about a revolution in the system so far as the supply of gun-carriages is concerned, by obtaining from Parliament a separate and distinct appropriation with which it is providing the English Navy with the Vavasseur gun-carriage in opposition to the will of Woolwich.

In the administration of the War and Navy Departments of the United States, each service has charge and direction of its own distinct system of artillery; hence if but one gun factory be provided, its control must be placed in the hands of a mixed commission. This must lead to conflict of authority and to embarrassments of all kinds, in which the heads of Departments must necessarily become involved. A close scrutiny of the practical difficulties that would arise in conducting the affairs of a gun factory in such mixed interests develops obstacles that would be insuperable even with the most harmonious intent.

In the selection of the sites mentioned, it is not intended to convey the idea that they are regarded as in every way adapted for the purpose, but, as the scope for choice is limited, they are considered the most advantageous. The Board does not recommend the purchase of new sites, as this would open so wide a field for selection as to embarrass the question by arousing local interests throughout the country.

(2.) What other method if any (apart from the establishment of a Government foundry), should be adopted for the manufacture of heavy ordnance adapted to modern warfare, for the use of the Army and Navy of the United States?

With Government gun *factories* established for both the Army and the Navy, there will be still needed the hearty co-operation of the private industries of the country. This cannot be aroused unless there is held out to them a fair prospect of remuneration. The Board does not approve of a partnership in business between the Government and private firms. *All history warns against such a course.* But it does believe that joint, and at the same time independent, action between them can be made to work harmoniously towards the common national purpose. This can only be done by a permanent and liberal appropriation by Congress for the specific purpose of providing the country with modern artillery;

which appropriation shall be a guarantee against loss to the companies who elect to undertake the work.

This is entirely consistent with the action of Congress in providing for the supply of arms to the militia. The act authorizing this practice was passed in 1808, and since that time the yearly disbursement has been made from the Treasury without interruption. A similar act providing for the supply of heavy ordnance for the regular services will be but a farther development of the same idea.

(3.) The cost of all buildings, tools, and implements, necessary to be used in the manufacture thereof, including the cost of a steam hammer or apparatus of sufficient size for the manufacture of the heaviest guns?

In reply to this question the Board presents an abstract of the information already given, arranged in a convenient form for reference.

Approximate cost of plant for producing the tempered parts of guns up to 100 tons, ready for delivery at gun factory:

Casting	$250,000
Forging (hydraulic press)	150,000
Rough boring and turning	210,000
Tempering	50,000
Total	660,000
Additional cost if liquid compression be adopted	175,000

Approximate cost of plant for gun factories:

Guns up to 6-inch caliber	50,000
Guns from 6-inch to 12-inch caliber	150,000
Guns from 12-inch to 16-inch caliber	350,000
Buildings and shrinking pit	350,000
Total	900,000

Three years will be required to complete the tools, construct the shops and establish the plant. Such a factory will be able to turn out per year fifty 6-inch, seventeen 12-inch, and twelve 16-inch guns, or a proportionally larger number of smaller calibers, at a yearly expense of about $2,000,000. The figures cannot be pronounced exact, but the Board is confident that they closely approximate accuracy. The calculations are based upon estimates obtained abroad, and do not include ocean freight and customs dues.

Though the act of Congress replied to in the above report is one of inquiry, the Board desires to emphasize the necessity of a proper encouragement to the private steel manufacturers, which shall insure the supply of gun material without loss to the Government or private companies; and is of opinion if Congress shall be pleased to appropriate an adequate sum for providing modern artillery for the Army and Navy, to be held in the Treasury to be expended under the authority of the President, that (with such a prospect of remuneration) there are steel manufacturers in the United States who will undertake the production of gun-metal on a large scale, on the sole condition that their steel shall meet the required tests. Unless such action be taken, the Government will be compelled to purchase its gun-metal abroad, for it will be unreasonable to expect private parties to invest over half a million dollars in plant without a definite prospect for its employment.

The facts that the United States is destitute of the means of fabricating the modern guns so urgently needed for national defense, and that at least three years will be required to complete the tools, construct

the shops and establish the plant, would seem to demand an immediate appropriation of the amount ($1,800,000) estimated for the establishment of the proposed gun factories.

E. SIMPSON,
Rear-Admiral, United States Navy, President of the Board.
E. O. MATTHEWS,
Captain, United States Navy.
T. G. BAYLOR,
Colonel of Ordnance, United States Army.
HENRY L. ABBOT,
Lieutenant-Colonel of Engineers,
Brevet Brigadier-General, United States Army.
SAM'L S. ELDER,
Major, Second Artillery, United States Army.
W. H. JAQUES,
Lieutenant, United States Navy,
Member and Secretary of the Board.

APPENDICES.

APPENDICES.

APPENDIX A.

[Copy of circular letter to steel manufacturers.]

COMMANDANT'S OFFICE, NAVY-YARD, LEAGUE ISLAND,
Philadelphia, May 1, 1883.

GENTLEMEN: I forward herewith a copy of a precept issued by the President of the United States, under the provisions of an act of Congress, appointing a Board charged with the duties mentioned in the order. Besides the consideration of the establishment a Government foundry pure and simple, and the determination of the suitability for purpose of any site now the property of the Government, the Board desires to be in-med as to the disposition of the steel manufacturers in the country to assist the object be obtained, namely, to enable the Government to produce at home from its own ma-l and manufacture the heaviest ordnance required for modern warfare.

.. e Board is informed of the propositions made to the steel manufacturers by the Chiefs dnance under dates of February and April, 1883, in which certain requirements are sented, but in the calls thus made the size of the castings does not exceed what would suitable for the tubes of 8-inch guns.

onsidering the subject as now presented by the Board your attention is asked to the hat its interrogatories are intended to include the manufacture of steel guns up to tons' weight. It is further desired that you will carefully consider the methods of ifacturing gun steel now employed in England, France, Germany, and Russia, with w to the selection of any of the methods for its manufacture.

Board requests that you will consider the following problem, namely: Given your t plant, what aid would you require from the Government in order so to enlarge o be able to manufacture the heaviest ordnance, the work to include the entire cess of manufacture from the casting of the ingots to the finishing of the gun. The would require an itemized statement of buildings, tools, hammers, or apparatus, tes of cost.

Whether you conclude to consider this proposition or not, the Board requests a reply its communication, and will be glad to answer any question you may be pleased to present.

Respectfully,

E. SIMPSON,
Commodore, United States Navy, President of the Board.

APPENDIX B.

[Circular letter to South Boston Iron Company and to Paulding, Kemble & Co.]

COMMANDANT'S OFFICE, NAVY-YARD, LEAGUE ISLAND,
Philadelphia, May 1, 1883.

GENTLEMEN: Referring to your communications of December 15, 1882, and January, 1882, to the honorable the Secretary of the Navy, and the Chief of Ordnance, War Department, in relation to the establishment of a plant capable of manufacturing the heaviest ordnance required for modern warfare, the Board asks your attention to the inclosed copy of a precept issued by the President of the United States in accordance with an act

eration is also requested of the inclosed copy of a communication addressed constituted by the above-mentioned act, to the steel manufacturers of the

The act of Congress under which the present Board is organized is in the direction pointed out by your communications above referred to, and the Board will be glad if you will revise your proposition and so modify it as to reply to the interrogatory submitted as a problem in the inclosed letter to the steel manufacturers, as follows: "Given your present plant, what aid would you require from the Government in order so to enlarge it as to be able to manufacture the heaviest ordnance, the work to include the entire process of manufacture from the casting of the ingots to the finishing of the gun."

Respectfully,

E. SIMPSON,
Commodore, United States Navy, President of the Board.

APPENDIX C.

6 OLIVER STREET,
Boston, May 8, 1883.

SIR: We have the honor to acknowledge the receipt of your circular letter dated the 1st instant, addressed to us, and also one of similar tenor addressed to the Norway Iron Works.

In reply to the same we regret to be obliged to say that, owing to contemplated changes at our works, we cannot at present hold out any prospect of being able to furnish the Government with steel guns such as are mentioned in your letter. Should we at a later date be in a position to supply them, we shall then be happy to take up the matter and furnish the board withestimates.

We are, sir, very respectfully yours,

NAYLOR & CO.

Commodore E. SIMPSON, U. S. N.,
President of the Foundry Board, Navy-Yard, League Island, Philadelphia, Pa.

APPENDIX D.

WEST POINT FOUNDRY,
Cold Spring, May 10, 1883.

SIR: We beg leave to acknowledge the receipt of your communication of May 1. The problem proposed to us is a difficult one, and we would inquire how much time you can allow us to look into the matter.

We would also ask you if you are correct in assuming that guns will be required from 6-inch to about 16-inch caliber, and if you can give some idea of the number of each kind which such an ordnance establishment should produce in the course of a year to meet the wants of the Government.

Very respectfully, your obedient servants,

PAULDING, KEMBLE & CO.

Commodore E. SIMPSON, U. S. N.,
President of Board, Navy-Yard, League Island.

APPENDIX E.

PARK, BROTHER & CO.,
Pittsburgh, Pa., May 10, 1883.

DEAR SIR: We are in receipt of your esteemed favor of 1st instant, and carefully note contents. We will take the matter into consideration, and write you further on the subject in a few days.

Yours, truly,

PARK, BROTHER & CO.

E. SIMPSON, Esq.,
Commodore, United States Navy, President of Foundry Board, Washington, D. C.

APPENDIX F.

OFFICE OF THE SOUTH BOSTON IRON WORKS,
70 Water Street, Boston, May 12, 1883.

SIR: I have the honor to acknowledge receipt of your communication of 1st instant with inclosures named. I have given much consideration to the subject concerning which you make inquiry, and realize its great importance. I propose to thoroughly study the question and obtain expert assistance in making such investigation, and in preparing such estimates and plans in detail as will enable me to present to your Board the design of a practical plant for the manufacture of heavy ordnance adapted to modern warfare, including a steam hammer or apparatus of sufficient size for the manufacture of the heaviest guns.

It will be three or four months before I shall have completed this work, as I contemplate a visit to the important establishments in Europe for consultation and observation.

Meanwhile, remain very respectfully, your obedient servant,

WM. P. HUNT,
President South Boston Iron Works

Commodore E. SIMPSON, U. S. N.,
President, &c., Commanding League Island Navy-Yard, Philadelphia.

APPENDIX G.

PITTSBURGH, PA., *May 22*, 1883.

DEAR SIR: Your favor under date of May 1 is at hand. Replying thereto we beg to say that we fear the expense of altering and adding large additional machinery to our present plant, which is new and improved, would be more than the Board would entertain. Our location in this market we claim is as good, if not better, than that of others for the shipping and hauling of heavy shapes, either by the Ohio River or by rail, and if the extra machinery was added to our plant, the ordnance required could be produced as cheaply and as effectively as at any other point in the country.

We would not entertain a proposition that would leave us high and dry when the present honorable commission retired, but must be guaranteed or subsidized for at least ten or fifteen years. This would insure safety to ourselves for changing, or allowing to be changed, our present plant, which is already adapted to turning out in the neighborhood of 12,000 tons of steel per annum, and would, we feel, be more satisfactory to the Government.

If the honorable Board would outline for us the size of plant governed by the number of guns, tonnage, &c., required, and about the sum the Government would limit itself to invest, we could more accurately inform ourselves what would be necessary.

We are, sir, yours respectfully,

PITTSBURGH STEEL WORKS,
ANDERSON, DU PUY & CO.

Hon. E. SIMPSON, Esq.,
Commodore, United States Navy,
President Board of Ordnance, Philadelphia, Pa.

APPENDIX H.

THE MIDVALE STEEL COMPANY,
Nicetown, Philadelphia, May 26, 1883.

DEAR SIR: Your circular letter of May 1, calling the attention of this company to the existence of the Board of which you are president, and to the object for which it has been created, came duly to hand and would have received a more prompt acknowledgment had we not been prevented from presenting the matter to the attention of our president, Mr. Wm. Sellers.

This company has given the subject of the manufacture of steel for ordnance considerable attention, and has had some success in the production of pieces of a moderate size—such, for instance, as are required for 6-inch breech-loading guns.

Our capacities are at present very limited for this sort of work, heavier than the above mentioned; but, from our past experience, we feel confident that in case we could be insured a sufficient amount of work to make the undertaking remunerative, we could, with proper appliances, produce successfully large masses of steel for ordnance purposes.

In considering the matter with a view of answering the Board's inquiry as to what additions would have to be made to our present plant in order to enable us to produce the parts of a 100-ton steel gun, we would now ask the Board to kindly furnish to us the approximate dimensions of the largest masses of steel required in the construction of a gun of this weight. We could then consider more intelligently the problem in question.

Awaiting the Board's reply, we remain,

Yours, respectfully,

R. W. DAVENPORT,
Superintendent.

Commodore E. SIMPSON, U. S. N.,
President Foundry Board, Navy-Yard, Philadelphia.

APPENDIX I.

PITTSBURGH, PA., *May* 24, 1883.

DEAR SIR: Referring again to your esteemed favor of 1st instant, would say our Mr. William G. Park will probably be in Philadelphia within a week and will then see you and discuss the subject thoroughly.

Yours, truly,

PARK, BROTHER & CO.

E. SIMPSON, Esq.,
Commodore, United States Navy,
President of Foundry Board, League Island, Philadelphia, Pa.

APPENDIX J.

SPRINGFIELD, ILL., *June* 2, 1883.

DEAR SIR: Your letter of May 1, in regard to the establishment of works for the manufacture of heavy steel guns, was duly received and has been considered. In reply, I have to say that this company has a plant consisting of three "Pernot" open-hearth steel furnaces, so arranged that we can readily cast ingots weighing say 40 gross tons. We could also easily arrange to increase the weight to 50 tons, and by the addition of one or two furnaces to 75 or even as high as 90 tons. I am not very familiar with the nature of the tools and other appliances which would be necessary to finish the different parts of the gun from the ingot; but suppose we have but little, if anything, in our plant that would apply. For this same reason I am not prepared to furnish an estimate of the amount of aid which we would require to enable us to prepare ourselves for the undertaking which you have in view. I can say, however, that we would be glad to co-operate with the Government in establishing a plant of the kind wanted, and that we would fit up our works with everything necessary upon being satisfied that it would receive a fairly remunerative business by so doing. Or we will, if it is preferred, and time can be given, procure estimates of the cost of whatever may be needed, and allow the Government to furnish the same on any fair understanding as to what compensation we shall receive for the use of what we now have. In this latter case we would request that you furnish the specification for an outfit of such a kind as you think will be best adapted to the purpose in view.

We think that this place affords some advantages for the business in contemplation. It is far enough inland to be at all times safe from interference from a foreign foe. Our transportation facilities are ample. We have an abundance of exceedingly cheap fuel and easy access to the best raw materials to be had in Missouri or on Lake Superior.

This company has been operating an iron-rail mill and bar mill very successfully for about twelve years, and is just completing a large mill for rolling steel plates of any thickness, and up to 110 inches wide. It is expected that this mill will be fully equal

to anything of the kind in the country. It is possible that it may be to the advantage of the Government to take some ship plates from this mill at some future time for use at some of the various navy-yards or on the western interior waters. It is also possible that our bar mill may be of use in furnishing some of the lighter parts to be used in the manufacture of steel guns of moderate weight.

Asking the favor of a reply, I am, yours, respectfully,

C. RIDGELY,
President.

Commodore E. SIMPSON, U. S. N.,
President Foundry Board, League Island, Philadelphia.

APPENDIX K.

SOUTH BOSTON IRON WORKS,
Boston, January 16, 1884.

SIR: Referring to your communication of May 1, 1883, inviting me to revise my proposition of January, 1882, referred to, and so modify it as to state what aid I should require of the Government to enable me to so enlarge our present plant as to be suitable for the manufacture of the heaviest ordnance required for modern warfare from the crude material, I now beg to say I have considered the problem carefully, and conclude that the subject is so important and comprehensive—so much depending upon information obtainable only in Europe, and of which I have obtained very little, compared with that in possession of your Board—I had better confine my estimates in reply to that portion of the proposed plant of which I have some practical knowledge, and so have considered the cost of such additional machinery and tools as would, with our present plant, enable us to machine-finish, from the steel-forgings or compressed ingots, modern steel guns at rates as follows:

Six guns of 16-inch caliber per year.
Twenty guns of 12-inch caliber per year.
Twenty guns of 10-inch caliber per year.
Thirty guns of 8-inch caliber per year.
Forty guns of 6-inch caliber per year.

I estimate the amount required to bring our plant up to this capacity would be $800,000, and require two years' time.

We desire to make this enlargement as soon as practicable, and ask the Government to advance the necessary money, under proper guards and restrictions, to be reimbursed to the Treasury when a reserve of 5 per cent. of all the income from said machinery and tools shall amount to a sum sufficient. With a reasonable volume of business the Government would be repaid in full within ten years.

Should your Board recommend this method to be adopted for the manufacture of heavy ordnance, but wish to provide for a complete establishment capable of producing the steel from the casting of the ingots, as well as the machine finishing of guns, I beg to refer you to my letter of January, 1882, referred to, and say I am ready to undertake the construction of the complete establishment upon the same terms as proposed for the machine department. In that event, I should expect to unite our works with that of the West Point Foundry Association, and move to such locality as would be approved by the Government authorities.

Very respectfully, your obedient servants.

SOUTH BOSTON IRON WORKS,
By WM. P. HUNT *President.*

Commodore E. SIMPSON, U. S. N.,
President Gun Foundry Board, Philadelphia.

APPENDIX L.

WEST POINT FOUNDRY,
Cold Spring, January 18, 1884.

SIR: Referring to your communications of May 1, 1883, respecting a plant to manufacture ordnance, we beg leave to make the following reply, which, in consequence of the questions asked us not being sufficiently definite, is necessarily approximate in its character.

Our establishment in its present state is capable of finishing a limited number of steel breech-loading guns, but is inadequate to the wants of the Government. We would leave it as it is, using it to the extent of its capacity for ordnance, and making projectiles, gun carriages, &c. (for which it is well adapted), if required. We would then propose to build an entirely new plant, independent of the old one on our property, capable of turning out about 120 guns per year, ranging from 100 tons to 6-inch caliber or less, the necessary steel forgings to be furnished to us. We estimate the cost of such a plant, including buildings, engine and boilers, lathes, cranes, and other machinery, about $800,000.

As it would be impossible for us to procure the means to put up such a plant, the only plan which seems feasible to us is for the Government to advance the necessary amount under such conditions as may be deemed proper, and with a proviso for its ultimate repayment when 5 per cent. of the amount of ordnance business done on said plant shall be equal to the sum advanced, the United States to remain proprietors of the plant until it is paid for as proposed.

With regard to the making of steel forgings, we understand that your Board has obtained in Europe the necessary information, and have more knowledge of the subject than we have been able to procure. We have, therefore, only to say that we should be willing to get up a plant on the terms proposed for the construction plant should it be considered advisable by the United States to locate it on our property or to combine it in the same establishment as that in which the ordnance is finished.

We estimate that it would require about two years to create the construction plant, but we are not prepared to state how long it would take to put up the plant for making the steel forgings.

Very respectfully, your obedient servants,

WEST POINT FOUNDRY ASSOCIATION,
G. PAULDING, *President.*

Commodore E. SIMPSON, U. S. N.,
Chairman of Gun Foundry Board, Philadelphia.

APPENDIX M.

OFFICE OF CAMBRIA IRON COMPANY,
Philadelphia, January 31, 1884.

DEAR SIR: Will you kindly advise us when it would be convenient for a representative of our company to appear before your Board in regard to securing such information as you can furnish us and making answer to your circular letter of May 1, 1883.

Awaiting your reply, we are yours, truly,

POWELL STACKHOUSE,
Vice-President.

Commodore EDWARD SIMPSON,
President Foundry Board, 1727 *Pine street, Philadelphia, Pa.*

APPENDIX N.

OFFICE OF CAMBRIA IRON COMPANY,
Philadelphia, February 7, 1884.

DEAR SIR: Having received the impression that the Gun Foundry Board would, after its investigation in Europe, be prepared to give us some information that would assist in a reply to its circular letter of May 1, 1883, we have delayed submitting any proposition that would indicate our "disposition to assist the object to be obtained," or an estimate of the manner and amount of "aid" required "from the Government."

We are now informed by the Board that such information cannot, without injustice to other private interests, be given before the publication of its report. We, therefore, have the honor to submit the following, suggested by our long and valuable experience in the manufacture of steel, and our investigations upon the subject-matter of the Gun Foundry Board's letter of May 1, 1883.

As requested in that letter, we have (as far as time would permit, and as carefully as possible without making a special visit to Europe) considered "the methods of manufacturing gun steel now employed in England, France, Germany, and Russia, with a view to the selection of any of these methods for its manufacture." This careful consideration indorses the statement we have already made in person to your Board, that steel made by the open-hearth process is the most uniform; and that we believe we have the largest casting plant on this system in the United States, conducted by men of great experience. We further are of the opinion that our casting plant will meet the *present* requirements of the Government for gun metal, and if a sufficiently large contract or other guarantee against loss were given, we could rapidly develop it to meet increasing demands.

Like all other steel manufactories in the United States, we have no apparatus capable of forging the large ingots required for modern guns. Before embarking in a forging plant that must require an expenditure of from a quarter to a half million of dollars, we would await the opinion of the Board or the action of the Government in regard to the adoption of a hammer or a hydraulic press. We have been led to this conclusion by the great attention which is now given this question in England and the use of a hydraulic casting press in Russia; also, by the fact that a large number of shafts for English naval ships and a large quantity of steel furnished the Royal Arsenal and the works of Armstrong, Mitchell & Co. have been manufactured by Sir Joseph Whitworth, who casts and forges the steel for these purposes by haudraulic presses.

As the forging press is said to be cheaper and its effect equal to or better than the hammer, we would naturally adopt that method of forging, unless the Government in its contracts should require the metal forged with the hammer.

Our company has received invitations from the Ordnance Departments of both Army and Navy to furnish gun material, the castings for which are well within our capacity to make; but wanting a suitable apparatus to properly forge such castings, and in the absence of a sufficiently large contract to pay even the cost of small apparatus, and the risks attendant upon the development of a new branch of our industry, we did not deem it wise to undertake a small contract.

In regard to the problem you submitted, "Given your present plant, what aid would you require from the Government in order so to enlarge it as to be able to manufacture the heaviest ordnance, the work to include the entire process of manufacture from the casting of the ingots to the finishing of the gun," we have to state we have learned that England and France, two of the countries mentioned in your letter, separate the manufacture of the steel from the construction of the guns. As they have had long and valuable experience upon this subject it would seem that they have adopted this plan because it was the best.

In view of this fact we submit an approximate estimate of the amount to be expended to put our plant in a condition to supply the required steel for gun construction.

For the sum of $695,000 we could add to our present plant forging apparatus, tools to rough bore and turn, and appliances for tempering the material of such weight and sizes as we suppose the Government will demand. Of the above-named sum, $143,000 we estimate as duty at 45 per cent. ad valorem on tools it will be necessary to import from foreign makers experienced in their construction.

We desire to call the attention of the Board to the following statement of business facts and considerations, that it may judge of the capacity, both financially and technically, of the Cambria Iron Company to undertake the work required of a national foundry.

The works of the company are located at a sufficient distance from the seaboard to render them absolutely secure from attack by a foreign enemy, while at the same time they do not occupy an isolated position so that communication between them and

the exposed portions of the country would be either impossible or difficult for our own people. The works are situated directly on the main line of the Pennsylvania Railroad, which affords quick and safe communication between the East and the West, and also brings them within 80 miles of steamboat communication on the Ohio River at Pittsburgh. In addition to these transportation facilities, the works are also in direct rail communication with the Southern seaboard and the South itself by way of the Somerset and Johnstown Railroad, which is a thoroughly-built and well-equipped branch of the Baltimore and Ohio Railroad, which has eastern termini at Baltimore and Washington and Southern connections at these and other points; also a third trunk line between the seaboard and West, now under construction, passing a few miles south of Johnstown, and with which there will be direct connection. It may also be added that by way of the Pennsylvania Railroad and its connections at Harrisburg with the Northern Central Railway the works have an additional outlet to Baltimore, Washington, and the South.

The situation of the works of the Cambria Iron Company at Johnstown is one of great healthfulness, and it is comparatively sheltered from the extremes of both heat and cold, and is wholly free from all malarious influences, so that workmen can prosecute their various employments in all seasons without danger of interruption from intense heat or cold, or from the prevalence of epidemics. The healthfulness of the situation of the works, the constant employment which has been given to its workmen for twenty-nine years, the cheapness of the necessaries of life, and the facilities which have been afforded by the company for the acquisition of homes by heads of families, have greatly contributed to the building up at Johnstown and in its immediate and dependent suburbs of a steady, sober, intelligent, and moral class of skilled mechanics—a fact upon which we desire to place great stress, as an industrial community that is fixed and permanent and attached by home ties and associations to its place of employment is far less likely to engage in contentions and strikes at critical periods than one that is composed of floating and uncertain elements.

The works have been in existence and in operation for more than thirty years, and in this time an army of skilled workmen has been gathered together that for efficiency, fidelity, and variety of scientific and mechanical attainments is believed to be unsurpassed, if equaled, in our whole country.

The works of the Cambria Iron Company are not merely of a reproductive or finishing character, but they embrace every branch of a complete establishment devoted to the manufacture of iron and steel. The company owns its own coal mines, including extensive mines in the Connellsville coke region and other mines adjacent to the works at Johnstown; it owns its own iron-ore mines, some of which are adjacent to the works, while others are situated in the Lake Superior region and elsewhere; it produces its own pig-iron in furnaces that possess all the modern improvements; it has a large Bessemer steel plant, a large open-hearth steel plant, iron and steel rail and other rolling-mills, puddling and heating furnaces, wire mills, and facilities for the production of miscellaneous steel products.

The works have a capacity for the production of 300,000 tons of pig-iron and over 200,000 tons of steel per annum.

The company employs at the present time 9,000 workmen. It has its own mining and mechanical engineers, its own draughtsmen, and its own chemists.

These details are mentioned to show the varied experiences of the employés and officers of the company; its perfect control over the raw materials it uses, and consequently over the character of its products, and the facilities generally for the prompt addition to its works for the contemplated national foundry, and the equally prompt and faithful execution of such orders as would be required of it.

It only requires to be added that the financial ability of the Cambria Iron Company to comply with all its engagements cannot be questioned. * * * It owns absolutely all of its property, without intervening creditors, as it has no bonded nor floating debt: all its employés are regularly paid every month; it can always manufacture all the articles it now produces as cheaply as any of its competitors, and hence is in no danger of ever abandoning business as a manufacturer of iron and steel. If financial ability to execute a contract is desirable, then the Cambria Iron Company may truthfully be said to possess that requirement in an eminent degree; and if a reputation for energy, enterprise, conscientiousness, and complete success in the production of iron and steel of the best quality counts for anything, the Cambria Iron Company, it may also be truthfully said, possesses this reputation and has possessed it for many years.

In conclusion, we desire to inform the Gun Foundry Board that the Cambria Iron Company may be induced to undertake at once the development of its steel plant to meet the requirements for gun material if the United States Government will make a sufficiently large contract or give other positive guarantees which shall insure the Cambria Company adequate employment or sufficient profit to reimburse this large expenditure, the company on its part undertaking to meet the required tests.

If the Government desires to enter into any joint action by furnishing the means for the development of a plant, with a reserve for reimbursement, the foregoing statements indicate our ability to undertake such action under the most favorable conditions for the faithful execution of the work.

All of which is respectfully submitted.

CAMBRIA IRON COMPANY,
By E. Y. TOWNSEND, *President.*

Commodore E. SIMPSON, U. S. N.,
President of Foundry Board.

APPENDIX O.

BROWN'S HOTEL, DOVER STREET,
London, England, July 30, 1883.

SIR: I am requested by the Board appointed by the President, under the late act of the United States Congress, to examine and report on matters relating to the manufacture of cannon, to address you on the subject of a visit which we desire to make to the works of Mr. Fried. Krupp, at Essen.

From our preliminary conversation of this morning I understand your position to be at the outset as follows: That if the examination of the Board be confined to a study of the works for the purpose of gaining information for our Government, without holding out any prospect of ultimate advantage to the factory through purchase of material, the request for admission will not be granted.

In reply to this I desire to state that though this Board is not authorized in any way to commit the United States Government to any course of action, yet the recommendations that it may make are entirely at its own discretion.

The members of the Board are well aware of the great expense necessary before a gun-foundry establishment can be brought to a state of practical usefulness; they are also aware of the length of time that must elapse before a plant can be established or satisfactory work produced, and if it should be concluded by the United States Congress to supplement the present inquiry by directing that armaments shall be provided at once, it is very probable that the recommendations of this Board would be to purchase abroad.

In such a case, the information that we might gain by a close examination of the manufacture of steel and the fabrication of guns and ammunition at the works of Mr. Krupp might greatly influence the direction of our recommendations.

If this view of the case will satisfy the implied condition of ultimate profit to the establishment, I will be glad to hear from you to that effect, and I request that this communication may be received as an official application for permission to visit the works.

Very respectfully,

E. SIMPSON,
Commodore, United States Navy, President of the Board.

(Care of B. F. Stevens, United States Dispatch Agent, 4 Trafalgar Square, Charing Cross, London.)

ALFRED LONGSDON, Esq.

APPENDIX P.

[Fried. Krupp's Cast-Steel Works, Essen, Rhenish Prussia.]

9 NEW BROAD STREET,
London, July 21, 1883.

SIR: I am duly in receipt of your esteemed favor of the 30th instant, which accurately recapitulates the substance of our conversation yesterday. I have now fully laid the matter before my Essen firm, and trust in a few days to write you fully thereon, and trust that a satisfactory solution of the question may be found; and in mean time, believe me, sir,

Yours, faithfully,

Pr. Pro. FRIED. KRUPP,
ALFRED LONGSDON.

BROWN'S HOTEL, *Dover Street W.*
Commodore E. SIMPSON, U. S. N.,
President of the Gun Foundry Board.

APPENDIX Q.

[Fried. Krupp's Cast-Steel Works, Essen, Rhenish Prussia.]

9 NEW BROAD STREET,
London, August 13, 1883.

SIR: I am now enabled to reply to your valued favor of 30th July, which has had the consideration of my Essen firm, and I beg to submit to you the following:

As it is presumed that your Commission has for its chief purpose the examination of the ordnance question in its characteristic of artillery efficiency, more than as a system of manufacture, which must be secondary, there does not appear to be so much necessity to see the works at Essen, where no data could be taken as to the value of the Krupp system as pieces of artillery. It would be of much higher consequence to you to examine the question of efficiency by a course of practice at the artillery practice-ground at Meppen, where guns of different calibers could be fired for all the essential ballistic properties attaching to them.

It is therefore proposed to place at your disposal the practice-ground at Meppen, and to fire there the different guns on the ground for range, accuracy, and general efficiency. and I shall be very glad if this meets with your acceptance. It is, however, of consequence that this should be decided without loss of time, because we are not allowed to fire after *September* 1 *till October* 15, on account of the harvest in the neighborhood. It will, therefore, be essential that the trials take place *this month*, and if you will kindly give me your decision a programme shall be drawn up for, say, the last days of the month. You may be sure that everything shall be done at Meppen to give you every information upon the superiority of our system of artillery. I shall be glad to have a telegram from you as early as possible, stating your decision, as I am leaving for Essen on Thursday morning.

The works at Essen cannot be seen, as these are closed to all but those who have special business of inspection of war material on order.

I am, sir, yours, obediently,

Pr. Pro. FRIED. KRUPP,
ALFRED LONGSDON.

Commodore EDWARD SIMPSON,
President of the American Artillery Commission.

APPENDIX R.

[Telegram.]

NEWCASTLE-ON-TYNE, ENGLAND,
August 14, 1883.

ALFRED LONGSDON,
9 *New Broad Street, London, E. C.:*

The Board regrets that it will be unable to accept the offer contained in yours of 13th instant. Letter by mail.

Commodore E. SIMPSON,
County Hotel, Newcastle-on-Tyne.

APPENDIX S.

THE COUNTY HOTEL,
Newcastle-on-Tyne, England, August 15, 1883.

SIR: On the part of the United States Gun Foundry Board, I have the honor to acknowledge the receipt of your favor of the 13th instant, in which I am informed that "the works at Essen cannot be seen, as these are closed to all but those who have special business of inspection of war material on order."

As the application of the Board was for permission to visit the works at Essen, your reply is therefore a notification that the request is refused.

The members of the Board appreciate your courtesy in placing at their disposal the practice-ground at Meppen, and your offer to exhibit the firing of guns for range, ac-

curacy, and general efficiency; but notwithstanding the great interest that would be taken in such experiments by the members of the Board, it is considered that the object of their mission would not be furthered thereby. With many thanks, therefore, for your considerate offer to view the efficiency of the Krupp manufacture by means of a course of practice, we regret our inability to accept it.

You will allow me to demur to your conclusion that "your Commission has for its chief purpose the examination of the ordnance question in its characteristics of artillery efficiency." On the contrary, it has for its object more the "system of manufacture," and I refer you to my letter of July 30, in which this view is presented.

Very respectfully,

E. SIMPSON,
Commodore, United States Navy, President of the Board.

FRIED. KRUPP'S CAST-STEEL WORKS, ESSEN, RHENISH PRUSSIA,
9 *New Broad Street, London, E. C.*

APPENDIX T.

[Fried. Krupp's Cast-Steel Works, Essen, Rhenish Prussia.]

9 NEW BROAD STREET,
London, August 16, 1883.

SIR: I beg to acknowledge your esteemed favor of yesterday, which has been forwarded to Mr. Longsdon, who has gone to Essen.

I have the honor to be, sir, your obedient servant,

For FRIED. KRUPP,
WALTER COWAN.

Commodore E. SIMPSON, U. S. N.,
President of the Gun Foundry Board,
The County Hotel, Newcastle-on-Tyne.

APPENDIX U.

ESSEN, RHENISH PRUSSIA,
September 1, 1883.

SIR: Your favor of 15th ultimo has been forwarded to me here, and I very much regret that you have not accepted my desire to be of such service to you as I could, if not in all the objects of your mission to Europe, still to make yourself acquainted by personal observation of the efficiency and general characteristics of my artillery, for I had conceived that at least this would have formed the first necessity, and that the process of the manufacture of a gun would have been second to the conviction as to which is really the most efficient system of artillery.

If you recollect during our conversation in London I endeavored to clearly point out to you that it was hardly to be expected that the process of manufacturing artillery upon my system could be shown to you, a process only arrived at by an immense expenditure of time and money, while on your side no compensation would be guaranteed, and that we should thus be upon unequal terms; and from your favor of 15th ultimo I can now gather that a simple walk through the Essen shops would even not be all that you would require, but that the system of construction should be made clear to you—an amount of information scarcely to be expected.

I was sincerely desirous of giving you every means of examining my gun as a piece of effective ordnance, and I inclose you a programme I had proposed to myself should be followed, and I think you will be assured that I had every desire of being thus far of service to you. The outlay for such a programme would be £500 at least, so that I was fully prepared to sacrifice this in your interest, and if you can visit the practice-ground at Meppen after 15th October, I will do my utmost still to show you all the courtesy and attention I can in this direction.

Should you desire to have a series of reports of trials with my guns of various calibers, showing their capabilities, I shall be happy to have a collection of them made for your disposal.

I am, sir, yours, very truly,

Pr. Pro. FRIED. KRUPP,
ALFRED LONGSDON.

Commodore EDWARD SIMPSON,
U. S. N., President of the Gun Foundry Board, London.

Draft of programme for United States Commission.

Caliber.	Numbers and kind of projectiles.	Pauses for—	Space of time.
			Minutes.
40-centimetre gun	2 common shells		20
		Change of position of frames	15
28-centimetre gun	5 armor-piercing shells		50
	5 common shells		25
		Change of position of frames	15
15½-centimetre gun	5 common shells		30
		Advance	15
15-centimetre mortar	5 common shells		15
	5 shrapnels		25
		Rest, including advance	120
8.7-centimetre gun	5 shells, 5 shrapnels		40
Light 7.5-centimetre gun	5 shells, 5 shrapnels		30
7.5-centimetre mountain gun	5 shells, 5 shrapnels		30
15.5-centimetre shield gun	10 shells		20
15-centimetre pivot gun	5 shells		20
			470

470 minutes=7 hours 50 minutes.

APPENDIX V.

PARIS, FRANCE. *September* 17, 1883.

SIR: On my return from an extended tour in France, I find your favor of the 1st instant, which I have laid before the Commission, and to which I hasten to reply.

The "draft of a programme for the United States Commission," inclosed in your letter, is of a most elaborate character, and very strongly confirms the statement therein that you were desirous of giving the Commission "every means of examining my [your] gun as a piece of effective ordnance," and it is hardly necessary for me to repeat that such an exhibition would be of the greatest interest personally to the members of the Commission. The estimated outlay for such a programme (£500) impresses us with the extent of the sacrifice you were prepared to make in this regard in the interest of the Commission.

The question of the effectiveness of the Krupp gun as a piece of ordnance, however, is not one which at this day can be disputed. The battle fought at Meppen in 1879, though bloodless, and without an enemy in the field, settled this question most decidedly, and you cannot suppose that the members of this Commission are ignorant of the results that have ensued. It is to be regretted that no representatives from the United States assisted at those experiments; but the results are known throughout the world. To witness a partial repetition of them would be excessively interesting, but it would impart no new information.

You will thus see that a "personal observation of the efficiency and general characteristics of my [your] artillery" was not necessary in order to satisfy us of its power; and as the time at our disposal was limited and our course of investigation indicated, we were forced to suppress personal inclination, and to conclude that time spent as you proposed would not be justified by the especial object of our mission. The courtesy of your proposition was thoroughly recognized, and I trust that our reasons for declining your modification of our request are accepted as a necessity arising out of the circumstances in which we are placed.

After being notified by you that the "works at Essen cannot be seen, as these are closed to all but those who have special business of inspection of war material on order," the Commission established for itself a programme, including a visit to the Aboukhoff Works at Alexandrovsky, which will prevent it from entertaining the idea of visiting the practice-ground at Meppen after the 15th of October, as suggested in your favor of the 1st instant, to which this note is a reply.

In conclusion, I desire to say that this Commission, though organized by act of Congress, and with its members appointed by the President of the United States himself, does not presume to question the perfect right of the authorities of any establishment to exclude it from its premises. Such rights are exercised by governments, and such

action is within the rights of any private corporation, and I deprecate the impression that may be conveyed that the non-attendance of the Commission at Meppen is the result of its exclusion from Essen.

The Commission is organized as a Gun Foundry Board; its essential work concerns itself with the arrangement of shops, the selection and position of tools, machines, &c.—in a word, with "installation." Matters of manufacture of metal, construction of guns, &c., come in as incidental, and bear much on the special object of its mission; but *gun-practice* is a luxury which can only be indulged in when the more essential features of its work do not engage the attention of the Commission.

Very respectfully,

E. SIMPSON,
Commodore, United States Navy, President of the Board.

FRIED. KRUPP, Esq.,
Per Alfred Longsdon, Esq.,
Essen.

RECORD OF PROCEEDINGS.

RECORD

OF THE

CONVENING SESSIONS AND PROCEEDINGS OF THE GUN FOUNDRY BOARD,

April 10, 1883, to February 8, 1884.

GUN FOUNDRY BOARD,
COMMANDANT'S OFFICE, NAVY-YARD, LEAGUE ISLAND,
Philadelphia, Pa., April 10, 1883.

The Board met at 10.45 a. m., in accordance with the precept issued by the President of the United States (File Book, p. 2), instructions received from the honorable Secretary of the Navy (File Book, p. 1), and order of Commodore Edward Simpson, U. S. N., senior member (Letter-Press Book, p. 3), and organized as follows:

Commodore Edward Simpson, United States Navy, member, president of the Board.
Capt. Edmund O. Matthews, United States Navy, member.
Col. Thomas G. Baylor, Ordnance Department, United States Army, member.
Lieut. Col. Henry L. Abbot, Engineer Corps, United States Army, member.
Maj. Samuel S. Elder, Second Artillery, United States Army, member.
Lieut. William H. Jaques, United States Navy, member, secretary of the Board.

All members present.

The precept and instructions were read by the president.

After discussion, the following were accepted as the principal requisites of location and adaptability of site:

Defensibility.
Possibility of expansion.
Convenience of proving and testing.
Proximity of iron.
Proximity of coal.
Proximity of skilled labor.
Proximity of water communication.
Character of foundation.
Salubrity of climate.

It was also decided to prepare letters to the Secretaries of War and the Navy asking for any information in their possession relating to the description, capacity, and cost of the equipment of European arsenals and foundries capable of casting and manufacturing the largest guns. Also, for plans of the various navy-yards and arsenals, said plans to cover the accepted requisites of location and adaptability.

It was further decided to prepare a circular letter to the steel manufacturers and gun factors asking what Government assistance would be necessary to enable them to undertake the casting and manufacture of the largest guns, inclosing copies of Army Ordnance Circular Letter and Army General Order No. 20. To be included in this is the estimate of a steam hammer for or other means of the manufacture of 80 and 100 ton guns.

After further discussion of plan of action, the Board, at 2 p. m., adjourned subject to call of president.

GUN FOUNDRY BOARD,
COMMANDANT'S OFFICE, NAVY-YARD, LEAGUE ISLAND,
Philadelphia, Pa., May 18, 1883.

Board met at 10.45 a. m., in pursuance of the order of its president of May 9, 1883.

All members present.

The record of the last meeting was read and approved.

The Board then proceeded to read and file communications. (File Book A, Nos. 12, 13, 15, 16, 18, 19, 20, 27, 28, 30, 31, 36, 37, 38.)

Read, considered, and placed on file the following correspondence: From Mr. Thomas S. Kennedy, of Louisville, Ky., offering his homestead as a site for the proposed foundry (File Book 6, 7, 8, 9, 33); from Senator Mahone, of Petersburg, Va. (File Book 24); and from Mr. George F. Tyler, president of the Norfolk and Western Railroad Company (File Book 29); and from Morgan, Williams & Co. (File Book 11).

The Board then proceeded with the discussion of the navy-yards and arsenals to be visited, and, after consideration of their location and adaptability, concluded for the present not to visit the following, viz: Beaufort naval station, S. C.; Key West naval station, Fla.; Mare Island navy-yard, Cal.; Pensacola navy-yard, Fla.; Augusta Arsenal, Ga.; Benicia Arsenal, Cal.; Fort Monroe Arsenal, Old Point Comfort, Va.; Indianapolis Arsenal, Ind.; Kennebec Arsenal, Augusta, Me.; New York Arsenal, Governor's Island, New York Harbor, and San Antonio Arsenal, Texas, leaving the following to be visited, viz: Boston navy-yard, Mass.; League Island navy-yard, Philadelphia, Pa.; New London naval station, Conn.; New York navy-yard, N. Y.; Norfolk navy-yard, Va.; Portsmouth navy-yard, N. H.; Washington navy-yard, D. C.; Allegheny Arsenal, Pittsburgh, Pa.; Frankfort Arsenal, Philadelphia, Pa.; Springfield Armory, Mass.; Rock Island Arsenal, Ill.; Watertown Arsenal, Mass.; and Watervliet Arsenal, West Troy, N. Y.

On motion, it was voted that the president of the Board be requested to communicate with the Secretaries of War and the Navy upon the subject of the advisability of visiting gun foundries in Europe, which, in its opinion, is necessary to gain the desired information.

After discussion of the course to be pursued in making the designated visits, the Board inspected the navy-yard, League Island, Philadelphia, and adjourned at 2.30 p. m. to meet in Norfolk, Va., on Tuesday, the 29th instant, to examine the Norfolk navy-yard.

GUN FOUNDRY BOARD,
Norfolk, Va., May 29, 1883.

Board met at 10.30 a. m., pursuant to adjournment. All members present.

Visited and examined the Norfolk navy-yard for the purpose of determining the advantages of this location for a Government foundry. After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this yard until further informed of the characteristics of other points to be visited in accordance with the President's order.

Read and filed communications, Pennsylvania Railroad (File Book 40), Anderson Du Puy & Co. (File Book 39), Park, Bro. & Co. (File Book 42).

At 2 p. m. adjourned to meet in Washington, D. C., Wednesday, the 30th instant.

GUN FOUNDRY BOARD,
Washington, D. C., May 30, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Visited and examined the Washington navy-yard for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this yard until further informed of the characteristics of other points to be visited in accordance with the President's order. The Board also inspected the ordnance work in progress at this yard.

At 3 p. m. adjourned to meet in Pittsburgh, Pa., Thursday, the 31st instant, at 10 a. m.

GUN FOUNDRY BOARD,
Pittsburgh, Pa., May 31, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Visited and examined the Allegheny Arsenal, Pittsburgh, Pa., for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this arsenal until further informed of the characteristics of other points to be visited in accordance with the President's order.

The Board also visited the Black Diamond Steel Works of Messrs. Park Brothers, and examined the operation of the seventeen-ton hammer, one of the largest in the United States. An investigation of the manufacture of steel at this establishment showed the metal was entirely produced by the Siemens process, applied not only to the open-hearth method, but also to the furnaces in which the crucible steel is made.

At 5 p. m. adjourned to meet in Johnstown, Pa., Friday, June 1, at 11 a. m.

GUN FOUNDRY BOARD,
Johnstown, Pa., June 1, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

Visited the Cambria Iron Works, and witnessed the operation of the production of steel by the Siemens open-hearth rotary furnace, of which there were two in operation, and another in process of constructioon, of a capacity of about 20 tons each. The Board also inspected the blast furnaces, steel-rail mills, and other works of this large establishment.

At 5.50 p. m. adjourned to meet subject to call of the president.

GUN FOUNDRY BOARD,
Cold Spring, N. Y., June 14, 1883.

Board met at 1 p. m., pursuant to adjournment. All members present.

Visited the Cold Spring Foundry and Gun Factory of Messrs. Paulding, Kemble & Co., and examined its site and the capacity and condition of its plant. The Board then proceeded to read and file communications. (File Book 49, 51, 52.)

At 4 p. m. adjourned to meet in West Troy, N. Y., Friday, June 15, at 9 a. m.

WEST TROY, N. Y., *June* 15, 1883.

Board met at 9 a. m., pursuant to adjournment. All members present.

Visited and examined the Watervliet Arsenal, West Troy, N. Y., for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this arsenal until further informed of the characteristics of other points to be visited in accordance with the President's order.

At 1 p. m. adjourned to meet in Springfield, Mass., Saturday, June 16, at 10 a. m.

GUN FOUNDRY BOARD,
Springfield, Mass., June 16, 1883.

Board met at 10 a. m., pursuant to adjournment.

Visited and examined the National Armory, Springfield, Mass., for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this armory until further informed of the characteristics of other points to be visited in accordance with the President's order.

Examined also the steam hammer, furnace, and hydraulic anvil erected in the works for the manufacture of the Hitchcock gun.

At 1 p. m. adjourned to meet in Boston, Monday, June 18, at 8.30 a. m.

GUN FOUNDRY BOARD,
Boston, Mass., June 18, 1883.

Board met pursuant to adjournment. All members present.

Discussed the suggested necessity of the employment of a mechanical expert and a recorder to accompany the Board during its European inspection, and concluded the employment of the latter was not necessary at the present time, and postponed action in regard to the former until the necessity of his services might be proved.

The Board then proceeded to Union Market, Mass., and examined the Watertown

Arsenal, for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this arsenal until further informed of the characteristics of other points to be visited in accordance with the President's order.

Examined also the Emory testing machine erected in these works and said to be the most excellent, delicate, and powerful testing machine in the world.

The Board then proceeded to Charlestown, Mass., and examined the Boston navy-yard, for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this navy-yard until further informed of the characteristics of other points to be visited in accordance with the President's order.

At 4 p. m. adjourned to meet at Portsmouth, N. H., Tuesday, June 19, 1883, at 8 a. m.

GUN FOUNDRY BOARD,
Portsmouth, N. H., June 19, 1883.

Board met at 8 a. m., pursuant to adjournment. All members present.

Visited and examined the navy-yard for the purpose of determining the advantages of this location for a Government foundry. After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this navy-yard until further informed of the characteristics of other points to be visited in accordance with the President's order.

At 11 a. m. adjourned to meet in Boston, Mass., Tuesday, June 19, 1883, at 2 p. m.

GUN FOUNDRY BOARD,
Boston, Mass., June 19, 1883.

Board met at 2 p. m., pursuant to adjournment. All members present.

Visited the South Boston Iron Works and Gun Factory, South Boston, Mass., and examined its site and the capacity and condition of its plant.

At 5 p. m. adjourned to meet in New London, Conn., Wednesday, June 20, 1883, at 10.30 a. m.

GUN FOUNDRY BOARD,
New London, Conn., June 20, 1883.

Board met at 10.30 a. m., pursuant to adjournment.

Visited and examined the New London naval station for the purpose of determining the advantages of this location for a Government foundry. After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this naval station until further informed of the characteristics of other points to be visited in accordance with the President's order.

At 3.30 p. m. adjourned to meet subject to the call of the president.

GUN FOUNDRY BOARD,
New York, N. Y., July 18, 1883.

Board met on board Cunard royal mail steamer "Servia," and left the United States for England, in accordance with orders of the Secretary of War (File Book A, p. 53) and the Secretary of the Navy (File Book A, p. 45). All members present.

GUN FOUNDRY BOARD,
London, England, July 27, 1883.

Board met pursuant to the order of its president. All members present.

The president was requested to communicate with the United States minister to England, and ask his aid in obtaining permission to visit the government establishments.

The Board then adjourned to meet Monday, the 30th instant, at 10 a. m.

GUN FOUNDRY BOARD,
London, England, Monday, July 30, 1883.

Board met at 10 a. m. pursuant to adjournment. All members present except Colonel Baylor, absent on account of sickness.

Sent communications. (Letter Book, pp. 118–120.)

Received and filed communications. (File Book B, p. 1.)

The Board then proceeded to pay an official call upon the honorable James Russell Lowell, United States minister, and accepted the invitation of Sir Joseph Whitworth, Bart., to call at his London office and inspect his systems of gun construction, projectile manufacture, and armor plating, with specimens of machines for testing same.

Adjourned at 4 p. m. to meet at 8 p. m.

GUN FOUNDRY BOARD,
BROWN'S HOTEL, DOVER STREET,
London, England, Monday, July 30, 1883.

Board met at 8 p. m., pursuant to adjournment. All members present except Colonel Baylor, absent on account of sickness.

The Board proceeded to discuss plans for future action, and requested the president to communicate with the following-named manufacturers in relation to its proposed visit to their works, viz: Alfred Longsdon, Fried. Krupp's Cast-Steel Works, 9 New Broad street, London; Thomas Firth & Sons, Norfolk Works, Sheffield; Charles Cammell & Co., Sheffield; Sir John Brown & Co., Sheffield; Sir William Armstrong, Mitchell & Co., Elswick, Newcastle-on-Tyne; Messrs. Vickers, Sons & Co., Sheffield; and Henry Bessemer & Co., Sheffield.

The president was also requested to address a letter to the honorable L. P. Morton, United States minister to France, asking his kind offices in securing, in advance of the arrival of the Board, permits from the French Government to visit their works at Puteaux, Ruelle, Bourges, Gâvre, and Sevran-Livry.

Sent communication. (Letter Book, p. 123.)

At 10.30 p. m. adjourned to meet Wednesday, August 1, at 9.30 a. m.

GUN FOUNDRY BOARD,
London, England, Wednesday, August 1, 1883.

Board met at 9.30 a. m., pursuant to adjournment. All members present except Colonel Baylor, absent on account of sickness.

Received from English war office, through Lieutenant-Commander Chadwick, naval attaché, and in answer to his request, a "list of machinery employed in the construction of steel B. L. guns in the Royal Gun Factory, Woolwich, together with a list of the addresses of the firms from whom the necessary appliances are procurable."

Sent communications. (Letter Book, pp. 126–132.)

Read and filed communication. (File Book B, p. 2.)

The Board then proceeded to the Royal Arsenal at Woolwich and visited the gun factories, after which it adjourned to meet to-morrow, Thursday, at 10 a. m.

GUN FOUNDRY BOARD,
BROWN'S HOTEL, DOVER STREET,
Thursday, August 2, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Read and filed communications. (File Book B, pp. 4, 5.)

Received a visit from Mr. Greenwood, of the firm of Greenwood & Batly, tool manufacturers, of Leeds. Discussed with him the subject of tools, particularly as to sizes and number requisite to perform certain work in a certain time. Mr. Greenwood proposed to prepare and submit to the Board a plan of works and an arrangement of shops and tools calculated to accomplish the work proposed by the Board.

Sent communications. (Letter Book, pp. 133, 134.)

The Board then visited and inspected the London Ordnance Works of Messrs. J. Vavasseur & Co., after which it adjourned to meet to-morrow, Friday, 3d instant, at 9.30 a. m.

GUN FOUNDRY BOARD,
London, England, Friday, August 3, 1883.

Board met at 9.30 a. m., pursuant to adjournment. All members present.

Read and filed communications. (File Book B, pp. 6–10.)

The Board then proceeded to the Woolwich Arsenal, visited the gun, carriage, and projectile factories, the laboratory, and witnessed a trial of the Vavasseur gun-carriage for 4-inch B. L. rifle.

Sent communications. (Letter Book, pp. 135–137.)

The Board then adjourned, to meet Tuesday, the 7th instant, at 9.30 a. m.

GUN FOUNDRY BOARD,
London, England, Tuesday, August 7, 1883.

Board met, pursuant to adjournment, at 9.30 a. m. All members present.

Read and filed communications. (File Book B, pp. 11–15 and 17.)

Sent communications. (Letter Book, pp. 138–143.)

The Board then proceeded to Woolwich Arsenal and continued its inspection, after which it adjourned, to meet subject to call of its president.

GUN FOUNDRY BOARD,
London, England, Wednesday, August 8, 1883.

Board met pursuant to adjournment. All members present.

Sent communication. (Letter Book, p. 145.)

Read and filed communication. (File Book B, p. 16.)

Accompanied by Mr. J. Vavasseur, of London, and Lieutenant-Commander F. E. Chadwick, naval attaché to the legation, London, the Board proceeded to Sheffield, and adjourned to meet to-morrow, Thursday, the 9th instant, at 10 a. m.

GUN FOUNDRY BOARD,
ROYAL VICTORIA HOTEL,
Sheffield, England, Thursday, August 9, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

The Board proceeded to the Norfolk Iron and Steel Works of Thomas Firth & Sons, Limited; witnessed a casting of crucible steel, and inspected the works.

Read and filed communication. (File Book B, p. 18*a*.)

Received from Varrall, Elwell & Middleton, constructing machinists, Paris, France, through Lieutenant-Commander Chadwick, tracings and descriptions of gun milling and drilling, breech-screw and planing and rifling machines now at Ruelle, France.

At 5.30 p. m. adjourned, to meet to-morrow, Friday, 10th instant, at 10 a. m.

GUN FOUNDRY BOARD,
ROYAL VICTORIA HOTEL,
Sheffield, England, Friday, August 10, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Sent communications. (Letter Book, pp. 146–148.)

Read and filed communications. (File Book B, p. 18.)

The Board then proceeded to the Atlas Steel and Iron Works of John Brown & Co., Limited, and witnessed the process of soldering iron and steel plates for armor, the Bessemer process of manufacture, and inspected the works.

At 3 p. m. the Board proceeded to the Iron and Steel works of Charles Cammel & Co., Limited, and witnessed the formation of a compound armor plate by the process of a steel casting upon a wrought-iron plate prepared for the purpose. Inspected the Bessemer plant and other parts of the works.

At 5.30 p. m., adjourned to meet to-morrow, Saturday, the 11th instant, at 10 a. m.

GUN FOUNDRY BOARD,
ROYAL VICTORIA HOTEL,
Sheffield, England, Saturday, August 11, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Read and filed communication. (File Book B, p. 19.)

The Board then proceeded to the River Don Works of Messrs. Vickers, Sons & Co., Limited; and inspected the forge and machine shops, but were not invited to view the process of steel manufacture.

At 1 p. m. adjourned, to meet on Monday, the 13th instant, at 10 a. m.

GUN FOUNDRY BOARD,
ROYAL VICTORIA HOTEL,
Sheffield, England, Monday, August 13, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Read and filed communication. (File Book B, p. 22.)

The Board then proceeded to the Bessemer Steel Works of Henry Bessemer & Co., Limited; inspected the works, and witnessed a five-ton casting by the Bessemer process and mechanical mixer or stirrer.

The Board then adjourned to meet in Newcastle-on-Tyne, Tuesday, the 14th instant, at 8 p. m.

GUN FOUNDRY BOARD,
THE COUNTY HOTEL,
Newcastle-on-Tyne, England, Tuesday, August 14, 1883.

Board met pursuant to adjournment. All members present.

Read and filed communications. (File Book B, pp. 23–25.)

Sent communications. (Letter Book, pp. 149–152.)

The Board requested its president to communicate with the Fried. Krupp Cast Steel Works, regretting the Board's inability to accept the kind invitation to witness, at Meppen, an exhibition of the general efficiency of the Krupp manufacture.

The president was also requested to communicate with the United States minister to Russia, and ask his aid in obtaining permission to visit the Government establishments there.

Adjourned to meet to-morrow, Wednesday, the 15th instant, at 10 a. m.

GUN FOUNDRY BOARD,
THE COUNTY HOTEL,
Newcastle-on-Tyne, England, Wednesday, August 15, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Sent communication. (Letter Book, p. 153.)

The Board then proceeded to the Elswick Works, Sir W. G. Armstrong, Mitchell & Co., and inspected part of the ordnance works.

At 2 p m. adjourned to meet to-morrow, Thursday, the 16th instant, at 10 a. m.

GUN FOUNDRY BOARD,
THE COUNTY HOTEL,
Newcastle-on-Tyne, England, Thursday, August 16, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Sent communications. (Letter Book, pp. 155, 156.)

The Board then proceeded to Middlesbrough, and inspected the Cleveland Iron and Steel works of Bolchow, Vaughan & Co., and witnessed the production of steel by the basic process.

The Board then returned to Newcastle-on-Tyne, and at 5.30 p. m. adjourned to meet to-morrow, Friday, the 17th instant, at 10 a. m.

GUN FOUNDRY BOARD,
Newcastle-on-Tyne, England, Friday, August 17, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Read and filed communications. (File Book B, pp. 26, 27.)

The Board then proceeded to a further inspection of the Elswick Works, Sir W. G. Armstrong, Mitchell & Co.

At 3 p. m. adjourned to continue the inspection of these works to-morrow, Saturday, the 18th instant, and to meet on Monday, the 20th instant, at 10 a. m.

AUGUST 18, 1883.

By direction of the president, sent communications. (Letter Book, pp. 158, 159.)

GUN FOUNDRY BOARD,
THE COUNTY HOTEL,
Newcastle-on-Tyne, England, Monday, August 20, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Read and filed communications. (File Book B, pp. 28, 29.)

Received accompanying drawings and descriptions of 4-foot sliding-gap lathe and 3-foot screw cutting and sliding lathe from Varrall, Elwell & Middleton, of Paris, France.

Sent communication. (Letter Book, p. 160.)

The Board then proceeded to make another visit to the Elswick Works, after which it adjourned to meet to-morrow, Tuesday, the 21st instant, at 11 a. m., in Leeds.

GUN FOUNDRY BOARD,
QUEEN'S HOTEL,
Leeds, England, Tuesday, August 21, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

The Board proceeded to the offices and works of Messrs. Greenwood & Batey and inspected plans of machinery and tools for the manufacture of guns.

At 2 p. m. adjourned to meet to-morrow, Wednesday, the 22d instant, at 10 a. m., in Manchester.

GUN FOUNDRY BOARD,
QUEEN'S HOTEL,
Manchester, England, Wednesday, August 22, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

The Board proceeded to the office and works of Messrs. Hulse & Co., and inspected plans of machinery and tools for the manufacture of guns.

At 1 p. m. adjourned to proceed to London, and meet subject to call of its president.

GUN FOUNDRY BOARD,
BROWN'S HOTEL, DOVER STREET,
London, England, Friday, August 24, 1883.

Board met at 8 p. m., at its president's call. All members present.

Read and filed communications. (File Book B, pp. 30, 31.)

Sent communication. (Letter Book, p. 161.)

After discussion, Board adjourned at 10 p. m., to meet in Paris, France, Wednesday, the 29th instant, at 10 a. m.

GUN FOUNDRY BOARD,
THE NORMANDY HOTEL, RUE DE L'ECHELLE,
Paris, France, Wednesday, August 29, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Received communication. (File Book B, p. 42.)

The Board then proceeded to pay an official call upon the Hon. L. P. Morton, United States minister to France, and visited the works of the "Société Anonyme des Anciens Etabl'ts Cail," Paris.

The Board then adjourned to meet to-morrow, Thursday, the 30th instant, at 11 a. m.

GUN FOUNDRY BOARD,
THE NORMANDY HOTEL,
Paris, France, Thursday, August 30, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

The Board then proceeded, in company with Minister Morton and his first secretary of legation, to call upon the military governor of Paris, in accordance with the request of the French minister of war of August 18th, and left communication (File Book B, p. 43), after which the Board adjourned to meet to-morrow, Friday, the 31st instant, at 9.30 a. m.

GUN FOUNDRY BOARD,
THE NORMANDY HOTEL,
Paris, France, Friday, August 31, 1883.

Board met at 9.30 a. m., pursuant to adjournment. All members present.

Received communication (File Book B, p. 43) from the military governor of Paris, with his indorsement.

The Board then proceeded to visit the Établissement d'Artillerie de Puteaux, near Paris; after which the Board adjourned to meet to-morrow, Saturday, September 1, at 11 a. m.

GUN FOUNDRY BOARD,
THE NORMANDY HOTEL,
Paris, France, Saturday, September 1, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

After discussion, decided to leave Paris Monday, the 3d instant, at 8.45 a. m., for Angoulême, Bourges, Lyons, and Le Creusot.

The Board then proceeded to Sevran-Livry, near Paris, and inspected the powder factory and butts of Sevran-Livry.

Received and filed communications. (File Book B, pp. 34, 35.)

The Board then adjourned to meet Monday, the 3d instant, at 8 a. m.

GUN FOUNDRY BOARD,
Sunday, September 2, 1883.

Sent communications. (Letter Book, pp. 184–187.)

GUN FOUNDRY BOARD,
Paris, France, Monday, September 3, 1883.

Board met at 8 a. m., pursuant to adjournment. All members present.

The Board proceeded to Angoulême, France, by way of Orleans and Tours, to visit the gun factory of Ruelle.

Adjourned at 4 p. m. to meet to-morrow, Tuesday, the 4th instant, at 11 a. m.

GUN FOUNDRY BOARD,
GRAND HOTEL DU PALAIS,
Angoulême, France, Tuesday, September 4, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

Proceeded by carriage (40 minutes' drive) to Ruelle, and inspected the National Gun Foundry.

At 6 p. m. adjourned to meet to-morrow, Wednesday, the 5th instant, at noon.

GUN FOUNDRY BOARD,
Angoulême, France, Wednesday, September 5, 1883.

Board met at noon, pursuant to adjournment. All members present.

The Board then proceeded to Ruelle and continued its inspection of the National Gun Foundry there.

At 6 p. m. adjourned to meet to-morrow, Thursday, the 6th instant, at 9.30 a. m.

GUN FOUNDRY BOARD,
Angoulême, France, Thursday, September 6, 1883.

Board met at 9.30 a. m., pursuant to adjournment. All members present.

The Board then proceeded, via Tours and Vierzon, to Bourges, where it arrived at 8.45 p. m., and adjourned to meet to-morrow, Friday, the 7th instant, at 9.45 a. m.

GUN FOUNDRY BOARD,
GRAND HOTEL DE LA BOULE D'OR,
Bourges, France, Friday, September 7, 1883.

Board met at 9.45 a. m., pursuant to adjournment. All members present.

The Board then proceeded to pay an official call, accompanied by Lieutenant-Commander Chadwick, naval attaché to the legation, London, upon General Schnéegans, commandant of the eighth army corps, and then visited and inspected the gun factory of Bourges; after which it adjourned to meet to-morrow, Saturday, the 8th instant, at 8 a. m.

GUN FOUNDRY BOARD,
Bourges, France, Saturday, September 8, 1883.

Board met at 8 a. m., pursuant to adjournment. All members present.

The Board then proceeded to Lyons, France, via Sanscaize, Moulins, Roanne, and L'Arbresle, and adjourned at 9 p. m. to meet Monday, the 10th instant, at 8.30 a. m.

Received communications. (File Book B, pp. 36–38.)

GUN FOUNDRY BOARD,
GRAND HOTEL DE LYON,
Lyons, France, Sunday, September 9, 1883.

By direction of the president sent communication. (Letter Book, p. 188.)

GUN FOUNDRY BOARD,
GRAND HOTEL DE LYON,
Lyons, France, Monday, September 10, 1883.

Board met at 8.30 a. m., pursuant to adjournment. All members present except Colonel Baylor, absent on account of sickness.

The Board proceeded to Terre Noire, inspected the works of the "Compagnie des Founderies et Forges de Terre Noire, La Voulte et Bessèges," and witnessed experiments with the Ripley-Hope steel gun of 127 millimetres.

The Board then returned to Lyons and adjourned to meet to-morrow, Tuesday, the 11th instant, at 9 a. m.

Received from the War Office, Horse Guards, S. W., London, England, through Lieut. Commander F. E. Chadwick, United States Navy, naval attaché, permit to visit the works of fortification at Dover Turret.

GUN FOUNDRY BOARD,
Lyons, France, Tuesday, September 11, 1883.

Board met pursuant to adjournment and proceeded to St.-Chamond. All members present.

Inspected the works of the "Compagnie des Hauts-Fourneaux, Forges et Aciéries de la Marine et des Chemins de Fer à St.-Chamond (Loire)," witnessed the rolling of a compound plate (manufactured by the Wilson patent), the casting of a 16-ton ingot, and the forging of an ingot of the same weight under the 80-ton hammer.

The Board then returned to Lyons, and adjourned to meet to-morrow, Wednesday, the 12th instant, at 10 a. m.

Received and filed communication. (File Book B, p. 44.)

GUN FOUNDRY BOARD,
Lyons, France, Wednesday, September 12, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Proceeded to Chagny, France.

At 8 p. m. adjourned to meet to-morrow, Thursday, the 13th instant, at 7.30 a. m.

GUN FOUNDRY BOARD,
HOTEL DU COMMERCE,
Chagny, France, Thursday, September 13, 1883.

Board met at 7.30 a. m., pursuant to adjournment. All members present.

Proceeded to Le Creusot and inspected a part of the steel works of Henri Schneider & Co. Witnessed the tempering of a 24-centimetre gun-tube, and the casting of a 45-ton steel ingot.

At 5.30 p. m. adjourned to meet to-morrow, Friday, the 14th instant, at 8.30 a. m.

GUN FOUNDRY BOARD,
HOTEL RODERIGUE,
Le Creusot, France, Friday, September 14, 1883.

Board met at 8.30 a. m., pursuant to adjournment. All members present.

Continued the inspection of the Creusot steel works and witnessed the forging of a 75-ton ingot under the 100-ton hammer.

At 6.45 p. m. adjourned to meet to-morrow, Saturday, the 15th instant, at 8 a. m.

GUN FOUNDRY BOARD,
Le Creusot, France, Saturday, September 15, 1883.

Board met at 8 a. m., pursuant to adjournment. All members present.

Proceeded to Paris, via Chagny, Dijon, and Fontainebleau.

At 6 p. m. adjourned to meet Monday, the 17th instant, at 10 a. m.

GUN FOUNDRY BOARD,
THE NORMANDY HOTEL,
Paris, France, Monday, September 17, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Read and filed communications. (File Book B, pp. 39–41.)

It was resolved to select a committee to visit St. Petersburg, Russia, to further the work of the Board, and Captain Matthews, United States Navy, Lieutenant-Colonel Abbot, United States Army, and Lieutenant Jaques, United States Navy, were appointed members of such committee.

The following committees were also appointed:

Colonel Baylor and Major Elder, United States Army, to consult with the tool manufacturers of Manchester and Leeds, England, during the absence of the committee in Russia.

Captain Matthews, United States Navy, and Lieutenant-Colonel Abbot, United States Army, on buildings.

Colonel Baylor and Major Elder, United States Army, and Lieutenant Jaques, United States Navy, on the number and placing of tools in shops.

The Board requested the president to communicate with the Hon. W. H. Hunt, United States minister to Russia, in relation to the visit of the committee to Russia; with M. Henri Schneider, of Le Creusot; M. Euverte, director of the Compagnie des Fonderies et Forges de Terre Noire; M. de Mongolfier, the director of the Compagnie des Hauts-Fourneax, Forges et Aciéries de la Marine et des Chemins de Fer à St.-Chamond (Loire); M. de Bange, the director of the Société Anonyme des Anciens Établissement Cail à Paris, acknowledging the courteous reception extended by them to the members of the Board; with the Hon. L. P. Morton, United States Minister to France, acknowledging the assistance rendered by the military and naval authorities of France and his own personal courtesies; and with Fried. Krupp, of Essen, per Alfred Longsdon, acknowledging the receipt of his letter of the 1st instant and expressing the impossibility of accepting his modification of the Board's request.

Sent communications. (Letter Book, pp. 190, 166).

At meridian Board adjourned to meet subject to call of its president.

GUN FOUNDRY BOARD,
Paris, France, Tuesday, September 18, 1883.

Board met at 2 p. m., at its president's call. All members present.

Accompanied by Minister Morton and his first secretary of legation, paid official calls upon the ministers of war and navy.

At 4 p. m. adjourned to meet subject to president's call.

GUN FOUNDRY BOARD,
Paris, France, Wednesday, September 19, 1883.

By direction of the president sent communications. (Letter Book, pp. 171–177.)

GUN FOUNDRY BOARD,
From September 19 *to October* 5, 1883.

Committee of Board appointed to visit Russia engaged in its duties; other members of the Board occupied in France and England, revisiting the arsenal at Puteaux, collecting information on wire construction in France, inspecting the works of Messrs. Hotchkiss & Co., at St.-Denis, and compiling and arranging the information collected.

GUN FOUNDRY BOARD,
Paris, France, Wednesday, September 26, 1883.

Sent communication. (Letter Book, p. 180.)

GUN FOUNDRY BOARD COMMITTEE,
HOTEL DE FRANCE,
St. Petersburg, Russia, Monday, September 24, 1883.

Committee met at 10 a. m. All members present.

Proceeded to pay an official call upon the Hon. William H. Hunt, United States Minister to Russia, who accompanied the committee to pay official calls upon the ministers of war and navy.

The committee then proceeded, in company with an aide-de-camp of General Obroutcheff, to pay an official call upon General Sophiano, chief of artillery, and adjourned at 3 p. m. to meet to-morrow, Tuesday, the 25th instant, at 9.30 a. m.

GUN FOUNDRY BOARD COMMITTEE,
St. Petersburg, Russia, Tuesday, September 25, 1883.

Committee met at 9.30 a. m., pursuant to adjournment. All members present.

Accompanied by Minister Hunt, proceeded to pay an official call upon the minister of the navy, Vice-Admiral Shestakoff (Le Vice-Admiral Shestakoff, aide-de-camp Général de S. M.).

The committee, accompanied by Captain Alexandre Von-der-Howen, Garde Artillerie (by direction of General Obroutcheff, acting minister of war), then proceeded to the St. Petersburg Arsenal ("Orondünoi Fawod") and inspected the work in hand, the small-arm ammunition shops and laboratory, after which, at 10 p. m., it adjourned to meet Thursday, the 27th instant, at 8 a. m. (Wednesday, the 26th instant, being a holiday).

GUN FOUNDRY BOARD COMMITTEE,
St. Petersburg, Russia, Thursday, September 27, 1883.

Committee met at 8 a. m., pursuant to adjournment. All members present.

Accompanied by Gunnery Lieutenant Raskazoff, Imperial Russian Navy (by direction of Admiral Shestakoff), proceeded in an admiralty steam launch to Obonkhoff, where the committee inspected the Obonkhoff Steel Works and Gun Factory.

At 5 p. m. adjourned to meet to-morrow, Friday, September 28, at 8 a. m.

Received communication. (File Book B, p. 49.)

Sent communications. (Letter Book, pp. 191, 192.)

GUN FOUNDRY BOARD COMMITTEE,
St. Petersburg, Russia, Friday, September 28, 1883.

Committee met at 8 a. m., pursuant to adjournment. All members present.

Accompanied by Gunnery Lieutenant Raskazoff and Captain Von-der-Howen, proceeded in the naval yacht Neva, Commander Satine, to Cronstadt, where, accompanied by Lieutenant-General Smaguine (commanding the artillery of Cronstadt) and staff, and Commander Skragin (representing Admiral Kazakewich), proceeded in steam launches to inspect the harbor, Forts Constantine and Milutin, the iron-clads "Peter the Great" and "Vladimir," and the naval torpedo manufactory.

At 7 p. m. returned to St. Petersburg, and adjourned to meet to-morrow, Saturday, the 29th instant, at 8 a. m.

GUN FOUNDRY BOARD COMMITTEE,
St. Petersburg, Russia, Saturday, September 29, 1883.

Board met at 8 a. m., pursuant to adjournment. All members present.

Accompanied by Gunnery Lieutenant Raskazoff, proceeded by carriage to the experimental grounds at Ochta, where, with Admiral Kouprianoff and staff and General Erme and staff, inspected the experimental batteries and armor targets.

At 3 p. m. adjourned to meet in London, Friday, October 5, 1883.

GUN FOUNDRY BOARD COMMITTEE,
London, England, Friday, October 5, 1883.

Committee met at noon, pursuant to adjournment. All members present.

The committee then proceeded to a general meeting of the Board.

GUN FOUNDRY BOARD,
London, England, Sunday, September 30, 1883.

Sent communication. (Letter Book, p. 193.)

GUN FOUNDRY BOARD,
BROWN'S HOTEL, DOVER STREET,
London, England, Friday, October 5, 1883.

Board met at meridian at its president's call. All members present.

Adjourned to meet to-morrow, Saturday, October 6, at 11 a. m.

GUN FOUNDRY BOARD,
London, England, Saturday, October 6, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

The Board then proceeded to the London office of Sir Joseph Whitworth, Bart., for the purpose of listening to his explanations relating to his process of the manufacture of steels, guns, and projectiles, after which the Board accepted his invitation to meet him and inspect his works at Openshaw, Manchester, on Tuesday, the 9th instant, at 11 a. m.

Having returned to its room, the Board then received the memorandum notes of the committee, lately returned from Russia, and the record of its proceedings.

The Board then adjourned to meet Tuesday, October 9, in Manchester, England, at 10 a. m.

GUN FOUNDRY BOARD,
Manchester, England, Tuesday, October 9, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

The Board then proceeded to and inspected the steel works of Sir Joseph Whitworth & Co. (Limited), at Openshaw, Manchester, and witnessed the casting, liquid compression, and hydraulic forging of steel by the Whitworth methods.

At 5 p. m. the Board proceeded to Rowsley, where, with Sir Joseph Whitworth, its deliberations were continued until 10 p. m., when the Board adjourned to meet in London, subject to call of its president.

The committee on number and placing of tools in shops was directed to proceed to Leeds, and upon the completion of its duties there to proceed to London.

GUN FOUNDRY BOARD,
London, England, Saturday, October 13, 1883.

Sent communications. (Letter Book, pp. 199, 200.)

GUN FOUNDRY BOARD,
BROWN'S HOTEL, DOVER STREET,
London, England, Monday, October 15, 1883.

Board met at call of its president.

After a visit to Woolwich Arsenal, the Board reassembled at 8 p. m. All members present.

Read and filed communications. (File Book B, pp. 45–57.)

Sent communications. (Letter Book, pp. 202, 203.)

The committee on tools reported its return from Leeds and Manchester, having completed its duties of inspecting the plans prepared for the information of the Board by Messrs. Greenwood & Batley and Tannett, Walker & Co., of Leeds, and Messrs. Hulse & Co., of Manchester. The Board then proceeded to read and examine various reports, and at 11 p. m. adjourned to meet to-morrow, Tuesday, the 16th instant at 8 a. m.

GUN FOUNDRY BOARD,
London, England, Tuesday, October 16, 1883.

Board met at 8 a. m., pursuant to adjournment. All members present except Commodore Simpson, absent on account of sickness.

The Board proceeded to Shoeburyness and witnessed a programme of practice prepared by direction of the director of artillery and stores.

At 8 p. m. Board adjourned to meet Saturday, the 20th instant, at meridian, on board the Cunard royal mail steamer "Scythia," at Liverpool.

GUN FOUNDRY BOARD,
London, England, Thursday, October 18, 1883.

By direction of the president, sent communications. (Letter Book, pp. 204-212.)

GUN FOUNDRY BOARD,
CUNARD ROYAL MAIL STEAMER "SCYTHIA,"
Liverpool, England, Saturday, October 20, 1883.

Board met at meridian, pursuant to adjournment, and left England for the United States in accordance with orders of the Secretary of War (File Book A, p. 53) and Secretary of the Navy (File Book A, p. 45). All members present.

Adjourned to meet subject to the call of its president.

GUN FOUNDRY BOARD,
CUNARD ROYAL MAIL STEAMER "SCYTHIA,"
At Sea, Monday, October 29, 1883.

Board met at 10 a. m. at the call of its president. All members present.

After discussion, the Board decided to proceed on Tuesday, November 6, to inspect the navy-yard, New York, and the arsenals at Frankford, Pa., and Rock Island, Ill.

At meridian adjourned to meet Tuesday, November 6, 11.15 a. m., at the navy-yard, New York.

GUN FOUNDRY BOARD,
New York, N. Y., Wednesday, October 31, 1883.

By direction of the president, sent communications. (Letter Book, pp. 214, 215.)

GUN FOUNDRY BOARD,
Navy-yard, N. Y., Tuesday, November 6, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

Examined the navy-yard for the purpose of determining the advantages of this location for a Government foundry.

After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this navy-yard until further informed of the characteristics of other points to be visited in accordance with the President's order.

At 3 p. m. the board adjourned to meet in Frankford, Pa., Wednesday, November 7, at 11 a. m.

GUN FOUNDRY BOARD,
Frankford Arsenal, Pennsylvania, Wednesday, November 7, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present.

Examined the arsenal here for the purpose of determining the advantage of this location for a Government foundry. After discussion and due consideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this arsenal until further informed of the characteristics of other points to be visited in accordance with the President's order.

At 2 p. m. the Board adjourned to meet at Rock Island, Ill., Saturday, November 10, at 10 a. m.

GUN FOUNDRY BOARD,
Rock Island, Ill., Saturday, November 10, 1883.

Board met at 10 a. m., pursuant to adjournment. All members present.

Visited and examined the Rock Island Arsenal for the purpose of determining the advantages of this location for a Government foundry. After discussion and due con-

sideration of the requirements indicated by the Board as a standard of reference, the Board reserved its decision in the case of this arsenal until further informed of the characteristics of other points to be visited, in accordance with the President's order.

At 5 p. m. the Board adjourned, to meet Tuesday, November 20, in Philadelphia, Pa at 11 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Tuesday, November 20, 1883.

Board met at 11 a. m., pursuant to adjournment. All members present except Capt. E. O. Matthews, United States Navy (absent on account of steamer detained by fog), and Col. T. G. Baylor, United States Army (absent on account of sickness).

Filed communications. (File Book A, pp. 59–66, and File Book B, pp. 58–60.)

Sent communication. (Letter Book, p. 117.)

After discussion the Board adjourned at 4.30 p. m., to meet to-morrow, Wednesday, the 21st instant, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Wednesday, November 21, 1883.

Board met at 10 a. m., pursuant to adjournment.

All members present except Colonel Baylor, United States Army (absent on account of sickness).

The Board then proceeded to read and examine a preliminary draft of its report.

The following resolutions were adopted:

It is inexpedient for the Government to undertake the manufacture of the steel for modern cannon.

It is desirable to provide Government factory facilities on a sufficient scale to perform the work of establishing standards, of making experimental guns, and of fabricating cannon on a modern scale, looking forward, however, to encouraging private establishments to embark upon this fabrication under the inspection of Government officers, as at present.

It is inexpedient to provide a single Government factory; two are essential—one for the Army and one for the Navy.

That on the receipt of price-lists, now awaited from abroad, the steel manufacturers shall be notified, as far as practicable, of the probable cost of plant, tools, &c., necessary for the manufacture of steel for cannon, including forging and tempering, and for the fabrication of the finished gun; and that they be requested to communicate to the Board what size of contract for guns or gun material will justify them in undertaking the production either of the material alone or of the finished gun.

The Board then proceeded to consider the selection of two sites to be recommended for Government gun factories, and decided upon the Watervliet Arsenal, West Troy, N. Y., for the purposes of the Army, and the Washington Navy-Yard, D. C., for the purposes of the Navy.

Received communication. (File Book A, p. 67.)

The Board at 4 p. m. adjourned to meet subject to the call of its president.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Tuesday, January 8, 1884.

Board met at 1 p. m., pursuant to call of its president. All members present except Maj. S. S. Elder, United States Army, absent (steamer detained by ice).

Received and filed communications. (File Book A, pp. 68–76, and File Book B, pp. 61–63).

Sent communications. (Letter Book, pp. 228–231.)

The president of the Board submitted a draft of the report. Engaged revising same until 4 p. m., when adjourned to meet to-morrow, Wednesday, January 9, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Wednesday, January 9, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

After further consideration of the resolutions adopted November 21, the Board deemed it inexpedient to furnish before the publication of its report the information therein indicated.

Engaged revising draft of report until 4.30 p. m., when adjournment to meet to-morrow, Thursday, January 10, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Thursday, January 10, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Received and filed communications. (File Book A, p. 79.)

Engaged revising draft of report until 4 p. m., when adjourned to meet to-morrow, Friday, January 11, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Friday, January 11, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Received and filed communications. (File Book A, pp. 77–81, and File Book B, pp. 64, 65.)

Sent communications. (Letter Book, pp. 232–238.)

Col. T. G. Baylor, United States Army, was excused from attendance on account of serious illness in his family.

Engaged revising draft of report until 5 p. m., when adjourned to meet to-morrow, Saturday, January 12, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Saturday, January 12, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present except Col. T. G. Baylor, United States Army, absent on account of serious illness in his family.

Received and filed communications. (File Book A, pp. 82–84.)

Sent communications. (Letter Book, pp. 239–241.)

Engaged in revising draft of report until 4.30 p. m., when adjourned to meet Monday, January 14, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Monday, January 14, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Messrs. William P. Hunt, G. Paulding, and T. Davis, representing the firms of the South Boston Iron Works and the West Point Foundry Association, appeared before the Board and submitted a verbal response to the circular letter addressed them by the Board May 1, 1883. The Board requested that they would submit their proposition in writing, which they agreed to do.

Engaged revising draft of report until 4.30 p. m., when adjourned to meet to-morrow, Tuesday, January 15, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Tuesday, January 15, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Received and filed communications. (File Book A, pp. 85, 86.)

Engaged revising draft of report until 4.30 p. m., when adjourned to meet to-morrow, Wednesday, January 16, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Wednesday, January 16, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Received and filed communication. (File Book A, p. 87.)

Engaged revising draft of report until 4.30 p. m., when adjourned to meet to-morrow, Thursday, January 17, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Thursday, January 17, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Engaged revising draft of report until 4 p. m., when adjourned to meet to-morrow, Friday, January 18, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Friday, January 18, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Engaged revising draft of report until 4 p. m., when adjourned to meet subject to call of its president.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Saturday, January 19, 1884.

By direction of president of the Board, sent communications. (Letter Book, pp. 242, 243.)

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Thursday January 21, 1884.

Board met at 1 p. m., at the call of the president. All members present.

Read and filed communications. (File Book A, pp. 88–91[a].)

Sent communications. (Letter Book, pp. 244 a, b.)

Engaged revising report until 4.30 p. m., when adjourned to meet to-morrow, Friday, February, 1, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Friday, February 1, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.

Received and filed communications. (File Book A, pp. 92, 93.)

Sent communication. (Letter Book, p. 244.)

Edward Y. Townsend, president, and Powell Stackhouse, vice-president of the Cambria Iron Company, appeared before the Board to call its attention to the capacity and quality of the Cambria steel casting plant, and to ask the Board for information that would assist in preparing a reply to the Board's interrogatories of May 1, 1883. They were informed that all the information the Board had to communicate would be found embodied in its report soon to be issued, and were requested to submit in writing any statement they wished to make in relation to the Cambria works.

Engaged in revising report until 4.30 p. m., when adjourned to meet to-morrow, Saturday, February 2, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Saturday, February 2, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.
Received and filed communication. (File Book A, p. 94.)
Sent communications. (Letter Book, pp. 245, 246.)
Engaged revising report until 3 p. m., when adjourned to meet subject to the call of its president.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA, PA.,
Thursday, February 7, 1884.

Board met at 1.30 p. m., at the call of its president. All members present.
Received communications. (File Book A, p. 95.)
[illegible]ed revising report until 4.15 p. m., when adjourned to meet to-morrow, Friday, [illegible]y 8, at 10 a. m.

GUN FOUNDRY BOARD,
1727 PINE STREET, PHILADELPHIA,
Friday, February 8, 1884.

Board met at 10 a. m., pursuant to adjournment. All members present.
Received communications. (File Book A, pp. 96, 97.)
Sent communications. (Letter Book, pp. 247, a, b, c, h.)
Considered the advantages of the site owned by the Government at Harper's Ferry, Va., formerly occupied as an armory.
Engaged revising report until 2.30 p. m., when it was adopted and the Board adjourned *sine die*.

NAVY DEPARTMENT,
Washington, D. C., Saturday, February 9, 1884.

By direction of the president of the Board filed communications (File Book A, p. 98), and sent communications (Letter Book, pp. 247 d, e).

NAVY DEPARTMENT,
Washington, D. C., Tuesday, February 12, 1884.

By direction of the president of the Board filed communications (File Book A, p. 99), and sent communications (Letter Book, pp. 247 f, g).

NAVY DEPARTMENT,
Washington, D. C., Saturday, February 16, 1884.

By direction of the president of the Board sent communication (Letter Book, p. 2471), and delivered report and communications (Letter Book, pp. 261, a, b) to the honorable Secretary of the Navy for transmission to the President.

Lieutenant W. H. JAQUES,
United States Navy, Member and Secretary of the Board.

MESSAGE

FROM THE

SIDENT OF THE UNITED STATES,

TRANSMITTING

plementary report of the Gun Foundry Board, dated December 20, 1884.

: 22, 1884.—Read, referred to the Committee on Military Affairs, and ordered to be printed.

EXECUTIVE MANSION,
December 22, 1884.

ate and House of Representatives:

mit herewith the supplementary report, dated December 20, de, in pursuance of orders of the Secretary of War and the ry of the Navy, by the Gun Foundry Board, appointed by me dance with the act of Congress approved March 3, 1883.

CHESTER A. ARTHUR.

SUPPLEMENTARY REPORT

OF THE

GUN FOUNDRY BOARD.

RECONVENED BY ORDER OF THE SECRETARY OF WAR AND THE SECRETARY OF THE NAVY.

CONTENTS.

APPENDICES.

SUPPLEMENTARY REPORT OF THE GUN FOUNDRY BOARD.

The Gun Foundry Board, reconvened by order of the Secretary of War, May 7, 1884 (Appendix A), and the Secretary of the Navy, April 29, 1884 (Appendix B), was directed:

1. To prepare plans and estimates for the preparation and purchase, both for the Army and the Navy, of plants for gun factories to complete guns from 6-inch caliber to 16-inch caliber, including buildings and shrinking-pit, and to report the full and detailed estimates for the cost of the work aforesaid.

2. To state whether the same can be better and more economically performed in establishments owned by the Government, or by private contract, or by a combined system whereby the said work can be accomplished partly by the Government and partly by private contract.

3. To make specific recommendations as to the best method of procuring steel for guns, and to indicate in what manner appropriations can most advantageously be made.

In accordance with its orders the Board met in Washington, D. C., May 15, 1884, and after due consideration appointed two committees, one composed of the army, the other of the naval members of the Board, to prepare plans and estimates for gun factories for their respective services, and addressed a circular letter (Appendix C) to the steel manufacturers of the United States, in order to procure opinions, based upon practical and business considerations, as to the best method of obtaining the required supply.

The Board has met with great difficulty in obtaining the desired information. No satisfactory replies having been received to its circular letter, the Board requested the assistance of Mr. James M. Swank, secretary of the American Iron and Steel Association, and by his efforts (Appendix L) and interest a meeting was effected with leading representatives of steel manufacture, which has enabled the Board to indicate the terms on which the manufacture of steel for guns of large caliber may be inaugurated in the United States.

In conclusion the Board has to report:

1. The total cost of each gun factory will be about $1,000,000.

The Army Committee has restricted its estimate (Appendix D) to the special tools for gun construction and to the erection of buildings, as indicated in the previous report of the Board, omitting such details as locomotives, cars, railway tracks, pipes for the transmission of power, crane tracks, boilers, engines, &c.

The estimate of the Naval Committee (Appendix I) includes these auxiliaries, with the exception of locomotives and cars, which swell the estimate accordingly. The buildings proposed by the two committees differ in form and arrangement, as might be expected, for quite different sites and local conditions. A careful study of the two projects has convinced the Board that when the estimates are reduced to the same standard there will be no essential difference between them.

bers to commence at the expiration of not more than eighteen
and that of the largest calibers at the expiration of not more than
years from the date of acceptance of the contract. Each b
specify the price of the parts for each of the several calibers.
may be modified by the Government in equity, according to the
rates of labor and material.

III.—Bids, to be considered, must be made by responsible
each of which shall certify and guarantee to erect in the Uni
a suitable plant capable of making all the steel required,
ing it, in accordance with the contract.

From personal intercourse with prominent steel makers
States, the Board is in a position to assert that prop
above basis will be responded to, but that it will be
priate the entire amount recommended in order to induce
steel manufacturers to erect and complete the plants to pr
steel for the guns needed for the national defense.

The above proposition contains only such a guarantee as
required by business men embarking in a new and expensive u
ing.

the quantity of material fabricated, and be estimated for from time to time by the Departments. With this exception, the total estimate of $17,000,000 will complete the steel-producing plant, establish and equip the steel gun factories, supply the guns for six and one-half years, and inaugurate the manufacture of steel in large masses in the United States.

E. SIMPSON,
Rear-Admiral, U. S. Navy,
President of the Board.
E. O. MATTHEWS,
Captain, U. S. Navy.
THOS. G. BAYLOR,
Colonel of Ordnance, U. S. Army.
HENRY L. ABBOT,
Lieutenant-Colonel of Engineers,
Brevet Brigadier-General, U. S. Army.
SAMUEL S. ELDER,
Major Second Artillery, U. S. Army.
W. H. JAQUES,
Lieutenant, U. S. Navy,
Member and Secretary of the Board.

WASHINGTON, D. C., *December* 20, 1884.

SUPPLEMENTARY REPORT

OF THE

GUN FOUNDRY BOARD

APPENDICES.

APPENDIX A.

NAVY DEPARTMENT,
Washington, April 30, 1884.

SIR: I have the honor to transmit herewith a copy of the letter of instructions to Rear-Admiral Edward Simpson, president of the Gun Foundry Board, and respectfully request that you may cause them to be communicated to the Army officers upon said Board, with directions to act in accordance therewith as members of the Board.

Very respectfully, your obedient servant,

WM. E. CHANDLER,
Secretary of the Navy.

Hon. ROBERT T. LINCOLN,
Secretary of War.

NAVY DEPARTMENT,
Washington, April 29, 1884.

SIR: You are hereby directed to reconvene the Gun Foundry Board, organized under the act of March 3, 1883.

The Board will prepare a plan and estimate for the preparation and purchase of plant for a gun factory to complete guns from 6-inch caliber to 16-inch caliber, including buildings and shrinking pit, and will report the full and detailed estimate for the cost of the work aforesaid, and whether the same can be better and more economically performed in establishments owned by the Government, or by private contract, or by a combined system, whereby the said work can be accomplished partly by the Government and partly by private contract, and in what annual instalments appropriations can most economically be made.

In case the Board shall be of opinion that the manufacture of the necessary gun material should be developed in this country by contracts with American manufacturers, the Board may communicate with, and receive proposals from, such manufacturers, and will cause to be prepared and submitted suitable contracts in detail ready for execution in case they shall be approved by Congress, and will make specific recommendations concerning the same.

The plans and estimates herein mentioned may provide for one gun factory for the Army and one for the Navy.

Respectfully,

W. E. CHANDLER,
Secretary of the Navy.

Rear-Admiral EDWARD SIMPSON,
President of the Advisory Board, Navy Department.

(First indorsement.)

Respectfully referred to the Adjutant-General to comply with the request of the Secretary of the Navy.

By order of the Secretary of War.

JOHN TWEEDALE,
Chief Clerk.

WAR DEPARTMENT,
May 5, 1884.

WAR DEPARTMENT, ADJUTANT-GENERAL'S OFFICE,
Washington, May 7, 1884.

Official copies respectfully referred to Col. T. G. Baylor, Ordnance Department, through the Chief of Ordnance, to Lieut. Col. H. L. Abbot, Engineer Corps, through the Chief of Engineers, and to Maj. S. S. Elder, Second Artillery, through Headquarters Department of the East, for compliance with the request of the Navy Department.

By order of the Secretary of War.

R. C. DRUM,
Adjutant-General.

Official copies.

R. C. DRUM,
Adjutant-General.

ADJUTANT-GENERAL'S OFFICE,
December 19, 1884.

WAR DEPARTMENT,
ADJUTANT-GENERAL'S OFFICE,
Washington, April 30, 1884.

SIR: Instructions having been issued for the reconvening of the Gun Foundry Board appointed by the President's order of April 2, 1883, the Secretary of War directs that you report to Rear-Admiral Edward Simpson, U. S. Navy, President of the Board, for duty on the same at such place and time as may be designated by him.

Rear-Admiral Simpson's address is, Naval Advisory Board, Navy Department, Washington, D. C.

The journeys to be performed are necessary for the public service.

Very respectfully, your obedient servant,

R. C. DRUM,
Adjutant-General.

Col. THOMAS G. BAYLOR,
Ordnance Department.
Through the Chief of Ordnance.

Official copy:

R. C. DRUM,
Adjutant-General.

ADJUTANT-GENERAL'S OFFICE,
December 19, 1884.

NOTE.—Similar letters were addressed to Lieut. Col. H. L. Abbot, Corps of Engineers, and Maj. Samuel S. Elder, Second Artillery.

APPENDIX B.

NAVY DEPARTMENT,
Washington, D. C., April 29, 1884.

SIR: You are hereby directed to reconvene the Gun Foundry Board, organized under the act of March 3, 1883.

The Board will prepare a plan and estimate for the preparation and purchase of plant for a gun factory to complete guns from 6-inch caliber to 16-inch caliber, including buildings and shrinking-pit, and will report the full and detailed estimate for the cost of the work aforesaid, and whether the same can be better and more economically performed in establishments owned by the Government, or by private contract, or by a combined system whereby the said work can be accomplished partly by the Government and partly by private contract, and in what annual installments appropriations can most economically be made.

In case the Board shall be of opinion that the manufacture of the necessary gun material should be developed in this country by contracts with American manufacturers, the Board may communicate with and receive proposals from such manufacturers; and will cause to be prepared and submitted suitable contracts in detail ready for execution in case they shall be approved by Congress, and will make specific recommendations concerning the same.

The plans and estimates herein mentioned may provide for one gun factory for the Army and one for the Navy.

Respectfully,

W. E. CHANDLER,
Secretary of the Navy.

Rear-Admiral EDWARD SIMPSON,
President of the Advisory Board,
Navy Department.

APPENDIX C.

GUN FOUNDRY BOARD,
NAVY DEPARTMENT,
Washington, D. C., May 15, 1884.

GENTLEMEN: There is forwarded to you herewith a copy of the Report of the Gun Foundry Board, organized by order of the President, April 2, 1883.

The report has been favorably received by Congress, and the Board is again in session for the purpose of supplying supplementary information looking towards the development of gun factories for the Army and the Navy.

In addition to what is contained in the report, your attention is particularly called to the following paragraph, included in the order under which the Board is now acting:

> In case the Board shall be of opinion that the manufacture of the necessary gun material should be developed in this country by contracts with American manufacturers, the Board may communicate with and receive proposals from such manufacturers, and will cause to be prepared and submitted suitable contracts in detail, ready for execution, in case they shall be approved by Congress, and will make specific recommendations concerning the same.

The Board is also directed to report "in what annual installments appropriations can most conveniently be made."

You will see from the report that the Board is very decidedly of opinion that the gun material should be developed in this country, and the object of now addressing you is to request from you such proposals as may guide the Board in its recommendations as to the annual appropriations to be made. You are requested to consider the classes presented under the head of "Cost of plant for the manufacture of guns," on page 40 of the report.

There will be required for the largest guns a capacity for casting an ingot of 100 tons. For 12-inch and for 6-inch guns there will be required a capacity for casting ingots of about 30 tons and 5 tons, respectively.

For forging these masses there will be required a hydraulic press, with its accessories; for the largest castings, one of 36-inch diameter will necessary; but for the smaller ones, presses of reduced power and may be substituted.

For rough boring and turning, there will be required a plant, as shown on page 41 of the report.

For tempering, there will be required a suitable furnace and k.

All the above operations will be required at the foundry parts will be received at the gun factories, and estimates of the c the appliances are stated in the report.

In whatever particular your works may be deficient in the s required above, you are requested to consider the out nec efficiently equip your establishment, and to determine tract for annual supply of gun material for a term of

justify you in incurring this expense for plant, your remuneration to be derived solely from the price paid by the Government for the material after passing the tests required.

As this subject is now before Congress, you are requested to provide the information asked for, at your earliest convenience. In considering the matter of a plant for the manufacture of gun material, the Board suggests that you do not lose sight of its availability for the manufacture of armor, for which a call may be made by the Government.

Very respectfully,

EDWARD SIMPSON,
Rear-Admiral, U. S. Navy, President of the Board.

APPENDIX D.

REPORT OF ARMY COMMITTEE OF GUN FOUNDRY BOARD.

PHILADELPHIA, PA., *December* 6, 1884.

SIR: The committee appointed at meeting of the Board of May 15, 1884, to prepare plans and estimates for the Army gun factory, reports as follows:

BUILDINGS.

Your committee deemed it necessary to visit Watervliet A: for the purpose of examining the grounds for a suitable location 1 buildings. It accordingly visited the arsenal on May 30, and, witu commanding officer, inspected what appeared to be the most a sites, and, after consideration, decided upon that marked in red ink the inclosed map of Watervliet Arsenal. (Appendix F.)

The buildings proposed for a plant for the fabrication of guns, fr a 6-inch to a 16-inch caliber, will be four in number, viz: Two turni and boring shops for heavy guns, one turning and boring shop for li guns, and a building for shrinking pit.

A plan and section of these buildings are shown in the t ing h with submitted. (Appendix E.) Their estimated cost wiu $350,000, without tools and without the railway and crane t ks, o ers and engines, for their service.

The general features of these buildings are given in the report of the Board of February 16, 1884, pages 44, 45, and 46.

MACHINES AND TOOLS FOR GUN FACTORY.

The machines and tools needed for this plant are given in the re of the Board of February 16, 1884, pages 42, 43, and 44, and y r co mittee simply adds to the list there given a one hundred ton c ie shrinking pit, and the sizes of the different machines. The lo these machines in the shops is shown in the inclosed tracing (Ap E).

If the cost of the boilers, engines, railway tracks, and tracl traveling cranes be added to the cost of the tools as herein giv increase this amount considerably.

Your committee deem the above, with the report of the Gun F Board of February 16, 1884, a sufficiently complete presentati plans and estimates for the Army Gun Factory.

T. G. BAYLOR,
Colonel of Ordnance, U. S. A., Chairman of Co
HENRY L. ABBOT,
Lieutenant-Colonel of Engineers, Brevet Brigadier-General, U. S. A
SAM'L S. ELDER,
Major Second Artillery, U.

Rear-Admiral E. SIMPSON,
President Gun Foundry Board,
Washington, D. C.

(4 inclosures.)

Four milling cutters and mortise drills for milling and drillin
chine.

The total cost will be about $150,000.

3. *For guns up to 16-inch caliber.*

Two finish turning lathes, 16 feet wide, 75 feet long.

Three finish boring, turning, and chambering lathes, 12½ feet wi(
feet long.

One machine to cut breech-screw, &c., 10 feet wide, 82 feet long

One rifling machine, 15 feet wide, 118 feet long.

One milling and drilling machine, 10 feet wide, 54 feet long.

Four combined boring and turning-face lathes for hoops, 14 feet
32 feet long.

Four combined boring and turning-face lathes for trunnion l
14 feet wide, 32 feet long.

One combined boring and turning lathe for trunnions, 7 feet wi
feet long.

One slotting machine for trunnion hoops, 12 feet wide, 15 feet l

One 100-ton power traveling crane.

Tools for the above, including—

Two cast-iron tubes, with steel boring head and cutters, for
boring tubes.

One cast-iron tube, with steel boring head and cutters, for f
ing jackets.

One steel chambering bar.

Fifty assorted turning tools, for finish turning lathes and machi
cutting breech screw and spaces.

One cast-iron hollow rifling bar, with cutter head, adjustments,
tube for actuating tool, and cutting tools.

Four milling cutters and mortise drills, for the milling and dı
machines.

The cost of above will be about $350,000.

To which add one 100-ton power traveling crane for shrinkin
$17,500.

Total cost, $367,500.

APPENDIX H.

RECORD OF PROCEEDINGS OF THE ARMY COMMITTEE OF THE GUN FOUNDRY BOARD.

GUN FOUNDRY BOARD, ARMY COMMITTEE,
New York City, May 29, 1884.

The committee met in Army Building at 11 a. m.

All the members present.

The committee examined a tracing of an arrangement of shops for a ın factory prepared from a plan suggested by Messrs. Greenwood and ley, of Leeds, England. The committee decided to visit Waterv t Arsenal to examine the ground to ascertain if a suitable site for the space required for these buildings could be found. A letter was written to the president of the Gun Foundry Board for the necessary orders to make this journey.

The committee at 12 m. adjourned to meet at Watervliet Arsenal May 30, 1884, at 10 a m.

GUN FOUNDRY BOARD, ARMY COMMITTEE,
Watervliet Arsenal, West Troy, N. Y., May 30, 1884.

The committee met at 10 a. m.

All the members present.

The committee, after a personal examination of the grounds, selected site which in its opinion seemed most suitable and desirable for the ection of the buildings as represented in the tracing before referred w.

The committee then adjourned subject to the call of the chairman, the members rejoining their respective stations.

S. S. ELDER, U. S. A.,
Major Second Artillery, Member of the Board.

APPENDIX I.

REPORT OF THE NAVAL COMMITTEE OF THE GUN FOUNDRY BO

PHILADELPHIA, PA.
December 6,

SIR: In pursuance to the action of the Board, May 15, 1884, a ing Rear-Admiral E. Simpson, Capt. E. O. Matthews, and Lieut. Jaques, of the Navy, a committee to prepare plans and esti a gun-factory plant for the Navy at the navy-yard, Washington, the committee has to report that it has given every detail as consideration as practicable, has communicated with a large nu the leading steel workers, machinists, and manufacturers, and ited those shops where it was informed the best systems could be and where the latest developments and modern improve been introduced.

The committee was everywhere received with courteous at and was enabled to make such examinations of the different me construction of buildings, foundations, drainage, roofing, lighting tilation, heating, arrangement and character of boilers and disposition of tools, transmission of power, precautions agai transportation and storage of material, supervision and econom ministration, as were necessary to reply to that portion of the instructions which directed it to "prepare a plan and estimate preparation and purchase of plant for a gun factory to complete from 6-inch caliber to 16-inch caliber, including buildings a ing-pit, and to report the full and detailed estimate for the c work aforesaid."

As a basis on which to make a "full and detailed estimate cost of" a factory adequate to "the work aforesaid," the commi poses a composite building of iron and brick, of the dimensions in the accompanying plans (Appendices J).

In designing this building the committee has been guided by t clusions reached by the Board and set forth in its report of F 16, 1884, under the head of buildings, page 44, and it has adop general features approved in that report, to wit:

1. Substantial foundations.
2. Strong but economical superstructures, secure against dest by fire.
3. Carefully-considered lighting arrangements.
4. Dimensions suited to the most convenient use of the to which avoid waste space under cover.

It was found that similar features had already been embodied construction of the new machine shop of the Dickson Manuf Company, in Scranton, Pa., and a study of this shop has as committee to its conclusions.

› avoid the very large expenditure for suitable foundations which wet, marshy character of the larger portion of the yard would re- e, the factory should be erected on the solid ground east of the ıue leading from the main gate south to the commandant's office, buildings now occupying this site to be removed. To complete whole structure on solid ground, as represented in the plans (Ap- lices J), it will be necessary to purchase a plot of ground (about 000 square feet) to the eastward of the present limits of the yard, n assessed valuation of $13,826 for the land and improvements eon.

may be said in this connection that the purchase of this land has frequently recommended by the authorities of the yard, as shown he following extract from the report of the civil engineer for the year ending June 30, 1869:

> e previous reports from this office in relation to this subject have all recommended xtension to be made in the same manner on the east and west sides of the yard. for this purpose are now presented, and it is earnestly and respectfully recom- led that the present limits of the yard be extended on the west as far as Canal t, including all south of M street, and on the east as far as Eleventh street, also ding all south of M street.

ıe proposed building will occupy three sides of a rectangle, 600 feet by 390 feet wide, with an inclosed court-yard 500 feet long and 140 in width. The western wing will run parallel to the avenue, at a ınce of about 100 feet, the main or southern portion to be advanced ls the river bank as far as the solid ground will permit. The west- wing will thus stand on the old ground of the yard, while the east- wing will occupy the ground to be purchased.

ıe northern ends of the building and court-yard will be connected l with the Baltimore and Potomac Railroad, and the southern ends a wing and the exits of the main building will be connected by with the water front.

ıe main building will cover a shrinking pit 16 feet in diameter and et deep, with horizontal re-heating furnaces abreast, and will be ided with two traveling cranes, one of 100 tons and one of 25 tons ity, of 50 feet hoist and span of 60 feet.

ıe east wing will contain the tools for the fabrication of the larger s of guns, up to 16-inch caliber, and will be provided with two eling cranes, one of 100 tons and one of 30 tons capacity, of 40 feet t and span of 60 feet.

ıe west wing will contain the tools for the fabrication of the smaller s, and will be provided with one 25-ton traveling crane of 40 feet hoist a n of 40 feet.

oiler-house, containing six boilers of 100 horse-power each, will ı ted in the court yard and will operate four engines, in houses, west sides of the wings, as follows: East wing, one of 150 horse- er, and one of 100 horse-power; west wing, one of 100 horse-power one of 75 horse-power. Exhaust steam will be employed for heat- The lighting will be from the roof and sides, and screens will be d under the roof to admit the direct light only from the northward.

ıe proposed factory will incorporate not only the best disposition of tools and appliances and the convenient and economical handling of gun parts, but will provide suitable spaces for the manufacture of carriages, the fitting of projectiles and other ordnance equipments, the braces and crane-frames will afford foundations for offices, draft- pattern, standard, and testing rooms, and the galleries for commu- tion and supervision.

The arrangement of the shops of the Dickson Manufacturing Company, ton, will strike most of our readers as being especially well considered. The are a feature which is eminently valuable. They have the advantage of co ing the working force and keeping the small tools within easy reach, whi same time they are entirely out of the way, and as completely isolated as t a shop by themselves or on another floor entirely closed in. The gallery a duces a feature of considerable advantage in making the same roof cover amount of floor space than would be possible under the strictly one-story ment. For small tools the amount of head room needed is not by any mean as for larger ones, and here advantage has been taken to place the large to open space, while the smaller ones are grouped either on the gallery floors o them.

By the completion of the main building, as proposed, and t tion of the wings to a length only sufficient to cover the machi tools recommended by the Board in its report of February 1 pages 42 to 44, inclusive, the estimated cost, including the purc the land, is $512,000, and the time necessary for completion, o

The above estimate, which, in addition to "buildings and sh pit," page 50, Gun Foundry Board's Report, February 16, 1884, boiler and engine-houses, boilers and engines, with their conn fitting of offices, wash and drafting rooms, purchase of additio grading and track-laying, and tracks and supports for cranes, up of the following items:

Iron-work ....
Frames and glass ....
Concrete ....
Granite ....
Brick-work ....
Roofs ....
Boiler and engine houses ....
Boilers and engines ....
Shrinking-pit ....
Offices ....
Grading and track-laying ....
Additional land ....

Total ....

This factory will meet present demands and be capable of sp largement by the extension of the wings; but as the present wa of the Navy are roughly estimated at 2,000 guns of various cali is evident that, even with the liberal aid of private industries, th capacity of the proposed building will be required to equip th with modern artillery within a reasonable time. The additio

[T]he estimated cost of tools will be:

...s up to 6-inch caliber	$50,000
...s from 6-inch to 12-inch caliber	150,000
...s from 12-inch to 16-inch caliber	350,000
...stated in the report of the Board previously referred to.	
...rder to accommodate the proposed building, two additional cranes will be required, at a cost of	30,000
The total cost of the tools will be	580,000

...ove are prices founded upon estimates obtained from tool mak... who have had years of experience in the manufacture, who have a ...t knowledge of the necessary adaptation to the peculiar demands of ...construction, and whose workmanship is being constantly tested in ... large gun factories in the world.

... committee has made every effort to obtain information as to the ...lity of our home industries to produce gun tools, and confirms the ...ement of the Board, page 8 of its report, February 16, 1884, that "no ...s or implements" for the fabrication of such guns—*the "heaviest"*— the act of Congress called for "have been manufactured or are in use [in] the United States."

[W]hile our own tool-makers signify, *in general terms*, their ability to ...ke gun tools of any size and power, the foremost of them admit that ...h time will be required for the preparation of designs and patterns ...ore they can produce tools equal in power, speed, and adaptability [to] those recommended by the Board.

[I]t is evident, therefore, that if it is desired to provide the factory ...h tools within a reasonable time, at a reasonable cost, and with a ...tainty that they will be able to perform all the work that may be re...red of them, with a rapidity capable of producing the maximum re...ts, this work must be *inaugurated* with tools of well-established rep...tion. In this connection it should be borne in mind there are but ... firms in Europe who have reached a position of excellence in this ...cialty, and this has only been achieved after many years of experi...[an]d competition.

...conclusion the committee reports the following summary of its de... estimates "for the preparation and purchase of plant for a gun ...tory to complete guns from 6-inch caliber to 16-inch caliber, includ... buildings and shrinking-pit":

...ldings and shrinking-pit	$511,556
...ls and implements	580,000
Total	1,091,556

E. SIMPSON,
Rear-Admiral, United States Navy,
Chairman of Committee.
E. O. MATTHEWS,
Captain, United States Navy.
W. H. JAQUES,
Lieutenant, United States Navy.

Admiral E. SIMPSON, U. S. N.,
President Gun Foundry Board.

CTION. EAST SIDE.

: 1".

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Tuesday, July 8, 1884.

The committee met at 10 a. m., pursuant to call of its chairman.
Rear-Admiral Simpson and Lieutenant Jaques present.
Preparing plans for gun factory.
Read and filed communication (File Book A, No. 115 A).
At 3.30 p. m. adjourned to meet subject to call of chairman.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
New York, N. Y., Monday, July 14, 1884.

The committee met at 7 p. m., at its chairman's call.
All members present.
Engaged preparing plans for gun factory until 11 p. m., when adjourned to meet to-morrow, Tuesday, the 15th instant, at 10 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
New York, N. Y., Tuesday, July 15, 1884.

The committee met at 10 a. m., pursuant to adjournment.
All members present.
Inspected the boilers, &c., of the New York Steam Heating Company, and the construction of the Grand Central Depot and Seventh Regiment Armory.
At 3 p. m. adjourned to meet to-morrow, Wednesday, the 16th instant, at 10 a. m., in Philadelphia, Pa.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Philadelphia, Pa., Wednesday, July 16, 1884.

The committee met at 10 a. m., pursuant to adjournment.
All members present.
Inspected the Midvale Steel Works, Nicetown, and the machine shops of William Sellers and Company, in Philadelphia.
At 4 p. m. adjourned to meet to-morrow, Thursday, the 17th instant at 9 a. m., in Scranton, Pa.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Scranton, Pa., Thursday, July 17, 1884.

The committee met at 9 a. m., pursuant to adjournment.
Captain Matthews and Lieutenant Jaques present.
Inspected the machine-shops of the Dickson Manufacturing Company, the Scranton Steel Works, and the Delaware, Lackawanna and Western Steel Works.
At 6 p. m. adjourned to meet to-morrow, Friday, the 18th instant, at 10 a. m., in Washington, D. C.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Friday, July 18, 1884.

The committee met at 10 a. m., pursuant to adjournment.

All members present.

Proceeded to the Washington navy-yard, and with Civil Engineer mocal, continued the preparation of plans and estimates for gun factory.

At 3 p. m. adjourned to meet subject to the call of chairman.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Newport, R. I., Friday, September 12, 1884.

The committee met at 7.30 a. m., Captain Matthews and Lieutenant Jaques present.

Read and filed communications (File Book A, Nos. 118, A, B, C, D).

Preparing plans for gun factory until 1 p. m., when adjourned to meet to-morrow, Saturday, the 13th instant, at 11 a. m., in Bridgewater, Mass.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Bridgewater, Mass., Saturday, September 13, 1884.

The committee met at 11 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Inspected the works of the Bridgewater Iron Company, and at 4 p. m. journed to meet Monday, the 15th instant, at 9.30 a. m., in Nashua, N. H.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Nashua, N. H., Monday, September 15, 1884.

The committee met at 9.30 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Inspected the works of the Nashua Iron and Steel Company, and at 3 p. m. adjourned to meet to-morrow, Tuesday, the 16th instant at 10 a. m., in Fitchburg, Mass.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Fitchburg, Mass., Tuesday, September 16, 1884.

The committee met at 9.30 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Inspected the machine-shops of the Fitchburg Machine Company and the Putnam Machine Company.

Filed communication (File Book A, No. 118 E).

At 5 p. m. adjourned to meet to-morrow, Wednesday, the 17th instant, at 9 a. m., in Troy, N. Y.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Troy, N. Y., Wednesday, September 17, 1884.

The committee met at 9 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Inspected the Troy and Rensselaer Steel Works (Albany Iron Works —Albany and R. Iron and Steel Company), and at 3 p. m. adjourned to e to-morrow, Thursday, the 18th instant, at 11 a. m., in Hartford, r.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Hartford, Conn., Thursday, September 18, 1884.

The committee met at 11 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Inspected the shops of the Colt Manufacturing Company, and at 5 p. m. adjourned to meet to-morrow, Friday, the 19th instant, at 9 a

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GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Hartford, Conn., Friday, September 19, 1884.

The committee met at 9 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Inspected the shops of the Pratt and Whitney Machine Comp and at 1 p. m. adjourned to meet subject to chairman's call.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Wednesday, September 24, 1884.

The committee met at 10 a. m., at its chairman's call.

Rear-Admiral Simpson and Lieutenant Jaques present.

Engaged preparing plans for gun factory until 3 p. m., when adjourned to meet to-morrow, Thursday, the 25th instant, at 10 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Thursday, September 25, 1884.

The committee met at 10 a. m., pursuant to adjournment.

Rear-Admiral Simpson and Lieutenant Jaques present.

Proceeded to the Washington navy-yard, and with Civil Engin Menocal continued the preparation of plans and estimates for gun tory.

At 3 p. m. adjourned to meet to-morrow, Friday, the 26th instant, at 10 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Friday, September 26, 1884.

The committee met at 10 a. m., pursuant to adjournment.

Rear-Admiral Simpson and Lieutenant Jaques present.

Preparing plans for gun factory until 4 p. m., when adjourned to meet to-morrow, Saturday, the 27th instant, at 10 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Saturday, September 27, 1884.

The committee met at 10 a. m., pursuant to adjournment.

Rear-Admiral Simpson and Lieutenant Jaques present.

Preparing plans for gun factory and with the Secretaries of War the Navy inspected the progress of the manufacture of the all-s guns (from 5-inch to 10 inch caliber) at the Washington navy-yard.

At 5 p. m. adjourned to meet subject to chairman's call.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Cleveland, Ohio, Monday, October 6, 1884.

The committee met at meridian at the chairman's call.

Captain Matthews and Lieutenant Jaques present.

Inspected the works of the Otis Iron and Steel Company, and at 10 p. m. adjourned to meet to-morrow, Tuesday, the 7th instant, at 8 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Cleveland, Ohio, Tuesday, October 7, 1884.

The committee met at 8 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Proceeded to Alliance, Ohio, and inspected the machine shops of the Morgan Engineering Company.

At 5 p. m. adjourned to meet to-morrow, Wednesday, the 8th instant, at 9 a. m., in Pittsburgh, Pa.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Pittsburgh, Wednesday, October 8, 1884.

The committee met at 9 a. m., pursuant to adjournment; proceeded to Bessemer Station, Pennsylvania, and inspected the shops of the Edgar Thomson Steel Works.

At 3 p. m. adjourned to meet to-morrow, Thursday, the 9th instant, at 9 a. m., in Washington, D. C.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Thursday, October 9, 1884.

The committee met at 9 a. m., pursuant to adjournment.

Captain Matthews and Lieutenant Jaques present.

Proceeded to the Washington navy-yard, and, with Civil Engineer Menocal, continued the preparation of plans and estimates for gun factory.

At 5 p. m. adjourned to meet Monday, the 13th instant, at 11 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Monday, October 13, 1884.

The committee met at 11 a. m., pursuant to adjournment.

All members present.

Proceeded to the Washington navy-yard, and, with Civil Engineer Menocal, continued the preparation of plans and estimates for gun factory.

At 5 p. m. adjourned to meet to-morrow, Tuesday, the 14th instant, 10 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Tuesday, October 14, 1884.

The c ittee met at 10 a. m., pursuant to adjournment.

All rs present.

Pr to the Washington navy-yard, and, with Civil Engineer tinued the preparation of plans and estimates for gun fac- communications (Letter Book, pp. 34, 35).

3 p. m. adjourned to meet subject to the chairman's call.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Tuesday, October 21, 1884.

By direction of chairman of committee, sent communication (Letter Book, p. 36).

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Wednesday, October 22, 1884.

The committee met at 10 a. m., at its chairman's call.

All members present.

Proceeded to the Washington navy-yard, and, with Civil Engineer Menocal, continued the preparation of plans and estimates for gun factory. Prepared draft of committee report. Read and filed communication (File Book A, No. 119).

At 5 p. m. adjourned to meet to-morrow, Thursday, the 23d instant, at 9 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Thursday, October 23, 1884.

The committee met at 9 a. m., pursuant to adjournment.

All members present.

Proceeded to the Washington navy-yard, and, with Civil Engineer Menocal, continued the preparation of plans and estimates for gun factory. Witnessed the operation of jacketing one of the Navy 8-inch all-steel hooped rifles. Prepared draft of committee report. Read and filed communication (File Book A, No. 120). Sent communication (Letter Book, p. 41).

At 5 p. m. adjourned to meet to-morrow, Friday, the 24th instant, at 9 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Friday, October 24, 1884.

The committee met at 9 a. m., pursuant to adjournment.

All members present.

Prepared draft of committee report. Read and filed communication (File Book A, No. 121). Sent communication (Letter Book, p. 44).

At 4 p. m. adjourned to meet to-morrow, Saturday, the 25th instant, at 9 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Saturday, October 25, 1884.

The committee met at 9 a. m., pursuant to adjournment.

All members present.

Proceeded to the Washington navy-yard, and, with Civil Engineer Menocal, continued the preparation of plans and estimates. Proceeded to the Bureau of Ordnance, Navy Department, and, with Capt. Montgomery Sicard, U. S. Navy, Chief of the Bureau, and Commander C. F. Goodrich, U. S. Navy, inspector of ordnance of the Washingt navy-yard, carefully reconsidered the requisites of a gun-factory plant for the fabrication of modern cannon. Sent communications (Letter Book, pp. 45, 46, 47).

At 5 p. m. adjourned to meet Monday, the 27th instant, at 10 a. m.

GUN FOUNDRY BOARD, NAVAL COMMITTEE,
Washington, D. C., Monday, October 27, 1884.

The committee met at 10 p. m., pursuant to adjournment.
All members present.
Sent communication (Letter Book, p. 50).
The committee then proceeded to a general meeting of the Board.

W. H. JAQUES,
Lieutenant, U. S. Navy.

APPENDIX L.

[Office of the American Iron and Steel Association, No. 261 South Fourth street.]

PHILADELPHIA, *November* 1, 18

GENTLEMEN: You are already familiar with the action of the ernment in appointing a Gun Foundry Board for the purpose of ob ing and reporting to Congress information relating to the best met to be adopted to supply the Army and Navy of the United States heavy ordnance adapted to modern warfare. In February last Board submitted to Congress an elaborate report, with the det which you are also already familiar. The Board is charged wit duty of presenting an additional report to Congress at the beginn the next session, on the first Monday in December next. This rep expected to be one of great interest to the manufacturers of steel in country, as it will probably contain definite suggestions for the facture of gun material for the Government, to be made of stee may be added that the interest taken by Congress at its last sessi the general proposition to establish in this country the manufact modern steel guns leads to the inference that this branch of the ernment will at its next session take definite action providing a li permanent appropriation for the supply of material for the manufa of these guns. Before presenting its additional report the Board sirous of receiving from the manufacturers of steel in this country definite proposals than it has yet received from any of them f manufacture of gun material. No satisfactory responses have be ceived to a circular letter which has been addressed by the Bo each of the manufacturers who were supposed to be prepared to the proposals referred to. The Board has especially received no sitions which could guide it in stating to Congress what size of co would induce manufacturers to undertake the manufacture of gu terial, or in what installments it would be desirable that appropr for this purpose should be made.

With the view of obtaining more definite information from stee ufacturers than has yet been received, I am officially advised president of the Gun Foundry Board that a consultation is desir its members with representatives of such firms of steel manufactu are willing to seriously consider the questions submitted by the and I am requested to arrange a meeting of these representative the members of the Board. In accordance with this request, and consultation with members of our executive committee, I respe invite your firm to send one or more representatives to confer wi Gun Foundry Board, at the office of the American Iron and Steel ciation, at Philadelphia, on Tuesday, November 11, 1884, at 11 o a. m., at which time and place an opportunity will be offered fo eral consultation with representatives of all the firms, and also sequent private consultations, if desired. The sessions of the Bo

›bably be continued for three days, but it is very important that at ˌue first session there be a full attendance of all who intend to be present the conference.

I will thank you to advise me promptly whether or not your firm will › represented at the conference, and if so, will you please furnish me th the name of your representative, or with the names of your repre- ıtatives if you conclude to send more than one?

Very respectfully, yours,

JAMES M. SWANK,
Secretary.

APPENDIX M.

RECORD OF RECONVENING, SESSIONS, AND PROCEEDINGS OF THE GUN FOUNDRY BOARD, FROM MAY 15, 1884, to DECEMBER 20, 1884.

GUN FOUNDRY BOARD,
Ebbitt House, Washington, D. C., Thursday, May 15, 1883.

The Board met at 11 a. m., in accordance with the instructions of honorable Secretary of War (Appendix A) and the honorable Secre of the Navy (Appendix B) and the order of its president.

All members present.

The instructions were read by the president.

Received, indorsed (Letter Book, p. 17), and returned a communi tion from the Louisville Board of Trade, forwarded by Hon. A. S. Wi through the Navy Department. Sent communications (Letter Book, pp. 15, 18, 20) and a copy of the Board's report of February 16, 1884, to J. W. Wright, superintendent Board of Trade, Louisville, Ky. Prepared a circular letter (Appendix C) and sent it to the following steel works:

Nashua Iron and Steel Company, Nashua, N. H.
Bridgewater Iron Company, Bridgewater, Mass.
Norway Steel and Iron Works.
Naylor & Co., 6 Oliver street, Boston, Mass.
Albany and Rensselaer Iron and Steel Company, Troy, N. Y.
Newark Steel Works, Newark, N. J.
New Jersey Steel and Iron Company, Trenton, N. J.
Midvale Steel Company, Nicetown, Philadelphia, Pa.
Bethlehem Iron Works, Bethlehem, Pa.
Pennsylvania Steel Works, Steelton, Pa.
Standard Works, 220 South Fourth street, Philadelphia, Pa.
Black Diamond Steel Works.
Park Brothers & Co., Pittsburgh, Pa.
Edgar Thomson Steel Works, 48 Fifth avenue, Pittsburgh, Pa.
Pittsburgh Steel Works, Pittsburgh, Pa.
Spang Steel and Iron Company, limited, Pittsburgh, Pa.
Cambria Iron and Steel Works, Johnstown, Pa.
Tredegar Iron and Steel Works, Richmond, Va.
Cleveland Rolling Mill Company, Cleveland, Ohio.
Otis Iron and Steel Works, Cleveland, Ohio.
Portsmouth Iron and Steel Works, Portsmouth, Ohio.
North Chicago Rolling Mill Company, Chicago, Ill.
Springfield Iron Company's Iron and Steel Works, Springfield, Ill.

Copies were also sent to Mr. J. M. Swank, secretary of the American Iron and Steel Association, for circulation and publication in the Bulletin of the association.

Rear-Admiral E. Simpson, Capt. E. O. Matthews, and Lieut. W. H. Jaques, of the Navy, were appointed a committee to prepare a plan and

imates for a gun-factory plant for the Navy at the navy-yard, Washon, D. C., in accordance with the precept; and Col. T. G. Baylor, rdnance Department, Lieut. Col. Henry L. Abbot, Engineer Corps, Maj. Samuel S. Elder, Second Artillery, of the Army, were appnted a committee to prepare a plan and estimates for a gun-factory ant for the Army at the Watervliet arsenal, West Troy, N. Y., in accordance with the precept.

At 3 p. m. adjourned, subject to call of the president.

GUN FOUNDRY BOARD,
From May 15 to October 27, 1884.

The committees appointed by the Board engaged in their duties. By direction of the president, sent the following communications: May 20, 1884 (Letter-book, p. 19); June 3, 1884 (Letter-book, pp. 23, 24); June 4, 1884 (Letter-book, p. 28); June 13, 1884 (Letter-book, p. 31); June 14, 1884 (Letter-book, p. 32); July 18, 1884 (Letter-book, p. 33); October 25, 1884 (Letter-book, pp. 48, 49).

GUN FOUNDRY BOARD, NAVY DEPARTMENT,
Washington, D. C., Monday, October 27, 1884.

The Board met at 11 a. m. at the call of its president.

All members present.

The record of the last meeting was read and approved.

The Board then proceeded to read and file communications (File-book A, Nos. 102 to 118, inclusive, and No. 122).

gaged reading reports and examining the plans presented by the committees appointed May 15, 1884.

At 4 p. m. adjourned to meet to-morrow, Tuesday, the 28th instant, at 10 a. m.

GUN FOUNDRY BOARD, NAVY DEPARTMENT,
Washington, D. C., Tuesday, October 28, 1884.

The Board met at 10 a. m. pursuant to adjournment.

All members present.

The record of the last meeting was read and approved. The reports d records of proceedings of the two committees appointed May 15, 1884, to prepare detailed plans and estimates for gun-factory plants were presented and considered.

No satisfactory replies having been received from the manufacturers ldressed by the Board in its circular letter of May 15, 1884, it was decided to address a communication (Letter-book, p. 51) to Mr. James M. Swank, secretary of the American Iron and Steel Association, requesting him to effect a meeting of the Board with the representatives of the leading firms engaged in steel manufactures in the United States in order that a conclusion might be reached as to the probability of receiving from them any proposals for the supply of gun material.

Read and filed communication (File-book A, No. 123).

At 3 p. m. adjourned to meet subject to call of the president.

GUN FOUNDRY BOARD,
Philadelphia, Pa., Tuesday, November 11, 1884.

The Board met at 11 a. m. at the call of its president.

All members present except Captain Matthews, U. S. N., detained by fog.

The record of the last meeting was read and approved.

Proceeded to the offices of the American Iron and Steel Association and met the following representatives of the leading firms engaged in steel manufacture in the United States:

Joseph R. Anderson, president of the Tredegar Iron Company, of Richmond, Va.; Samuel L. Felton, president, and Maj. L. S. Bent, vice-president and general manager, of the Pennsylvania Steel Company, of Steelton, Pa.; Edward Y. Townsend, president, and Powell Stackhouse, vice-president, of the Cambria Iron Company, of Johnstown, Pa.; William Sellers, president, and R. W. Davenport, superintendent, of the Midvale Steel Company, of Philadelphia, Pa.; John Fritz, superintendent, and Joseph Wharton, a director, of the Bethlehem Iron Company, of Bethlehem, Pa.; William G. Neilson, manager of the Standard Steel Works, of Lewistown, Pa.; Chester Griswold, vice-president of the Albany and Rensselaer Iron and Steel Company, of Troy, N. Y.

The stenographic minutes of the proceedings are filed (File-book A, No. 142 A).

Read and filed communications to Naval Committee of Gun Foundry Board (File-book A, Nos. 124 to 126 inclusive, and 129).

Read and filed communications (File-book A, Nos. 127, 128, and 1 to 142 inclusive). Sent communications (Letter-book, pp. 55, 60, 61, 62, 67).

At 5 p. m. adjourned to meet to-morrow, Wednesday, the 12th instant, at 9 a. m.

GUN FOUNDRY BOARD,
Philadelphia, Pa., November 12, 1884.

The Board met at 9 a. m. pursuant to adjournment.

All members present.

The record of the last meeting was read and approved.

At the request of the administration of the Bethlehem Iron Company, proceeded to Bethlehem, Pa., and inspected that company's works.

At 7 p. m. adjourned to meet to-morrow, Thursday, the 13th instant, at 10 a. m.

GUN FOUNDRY BOARD,
Philadelphia, Pa., Thursday, November 13, 1884.

The Board met at 10 a. m., pursuant to adjournment.

All members present.

The record of the last meeting was read and approved.

Messrs. William Sellers, president, and R. W. Davenport, superintendent, of the Midvale Steel Company; Edward Y. Townsend, president, and Powell Stackhouse, vice-president, of the Cambria Iron Company, appeared at their own requests before the Board and submitted verbal responses to the inquiries addressed them by the Board on Tuesday, November 11.

At 4 p. m. adjourned to meet to-morrow, Friday, the 14th instant, at 8 a. m.

GUN FOUNDRY BOARD,
Philadelphia, Pa., Friday, November 14, 1884.

The Board met at 8 a. m., pursuant to adjournment.

All members present.

The record of the last meeting was read and approved.

At the request of the administration of the Pennsylvania Steel Com-ıy, proceeded to Steelton, Pa., and inspected that company's works.

At 4 p. m. adjourned, to meet subject to the call of its president.

GUN FOUNDRY BOARD,
NAVY DEPARTMENT,
Washington, D. C., Thursday, November 20, 1884.

By direction of the president of the Board, sent communications Letter-book, pp. 68, 69).

GUN FOUNDRY BOARD,
Philadelphia, Pa., Friday, December 5, 1884.

The Board met at 10 a. m., at the call of its president.

All members present.

The record of the last meeting was read and approved.

Continued the consideration of the two committee reports and revised ft of supplementary report. Read and filed communications (File-ᴜᴏok A, Nos. 143 to 154, inclusive). Sent communication (Letter-book, p. 70, A).

At 11.30 p. m. adjourned, to meet to-morrow, Saturday, the 6th instant, at 9 a. m.

GUN FOUNDRY BOARD,
Philadelphia, Pa., Saturday, December 6, 1884.

The Board met at 9 a. m., pursuant to adjournment.

All members present.

The record of the last meeting was read and approved. Adopted the reports of the two committees and the supplementary report of the Board. Sent communication (Letter-book, p. 70).

The Board resolved that its president, when he deems expedient, l communicate with all who have furnished the Board with confiᴀential drawings and documents, and request instructions as to the disposition of said confidential communications.

At 2 p. m. adjourned, to meet subject to call of the president.

GUN FOUNDRY BOARD,
NAVY DEPARTMENT,
Washington, D. C., Wednesday, December 10, 1884.

By direction of the president of the Board, sent communication (Letter-book, p. 72).

GUN FOUNDRY BOARD,
NAVY DEPARTMENT,
Washington, D. C., Saturday, December 13, 1884.

By direction of the president of the Board, filed communications File-book A, Nos. 155 156); and sent communication (Letter-book, p. 75).

GUN FOUNDRY BOARD,
NAVY DEPARTMENT,
Washington, D. C., Sunday, December 14, 1884.

By direction of the president of the Board, sent communication (Letter-book, p. 76).

GUN FOUNDRY BOARD,
NAVY DEPARTMENT,
Washington, D. C., December 20, 1884.

By direction of the president of the Board, delivered supplementary report and communications (Letter-book, pp. 79, 80) to the honorable Secretaries of War and the Navy, and the Board adjourned *sine die.*

LIEUTENANT W. H. JAQUES,
United States Navy, Member and Secretary of the Board.

. 20.—PURCHASES BY CONTRACTS FOR SUPPLIES AND SERVICES, TO BE MADE BY ADVERTISING, ETC.

MEMORANDUM OF ACCOMPANYING PAPERS.

December 10, 1883.—The Secretary of the Navy calls attention to the chiefs of bureaus to sections 3709, 3718, and 3722, Revised Statutes, requiring all purchases by contracts for supplies and services to be made by advertising, with certain exceptions.

February 4, 1884.—The Secretary of the Navy, referring to the foregoing letter, and calling attention to the fact that there is no rule of the Department allowing purchases to be made in violation of sections 3709, 3718, and 3722, where the amount does not exceed $500.

July 3, 1884.—The Fourth Auditor of the Treasury, referring to recently discovered frauds in the Bureau of Medicine and Surgery, and suggesting some changes in methods and forms pertaining to the accounts and blanks now in use.

July 12, 1884.—The Secretary of the Navy to the chiefs of Bureaus, calling their attention to the foregoing letter and requesting them to ascertain the opinions of the Fourth Auditor, and confer with the Second Comptroller with a view to the adoption of the best and safest possible forms to be issued for vouchers for disbursements.

July 3, 1884.—The Fourth Auditor gives total of supplies paid for at the navy pay offices under contract, open purchase, and those exempt from contract or advertisement.

July 12, 1884.—The Secretary of the Navy, acknowledging the foregoing, stating that the large proportion of open purchases has been called to the attention of the chiefs of Bureaus, and saying he will be glad to examine the detailed statement at the first convenient opportunity.

July 12, 1884.—The Secretary of the Navy requesting the chiefs of Bureaus to again consider the subject of purchases of supplies for the Navy, and the Department's letters concerning the same, dated December 10, 1883, and February 4, 1884, also, quoting from the Fourth Auditor of the 3d of July.

July 12, 1884.—The Secretary of the Navy to the Second Comptroller of the Treasury, requesting that he will at an early date confer with the Chiefs of Bureaus of the Navy Department, either with each separately or at a meeting of all, with a view to the adoption of the best and safest possible forms to be issued for vouchers for disbursements of public money.

July 15, 1884.—The Second Comptroller, acknowledging the receipt of the foregoing, and stating that he will take pleasure in conferring with the chiefs of Bureaus.

July 16, 1884.—The Acting Secretary of the Navy (Rear Admiral Nichols), acknowledging the receipt of the foregoing and suggesting that the Comptroller meet the chiefs of Bureaus either on the 17th or 18th in the office of the Secretary of the Navy for the purposes indicated.

NAVY DEPARTMENT,
Washington, December 10, 1883.

SIR: Your attention is called to sections 3709, 3718, and 3722, Revised Statutes, which require all purchases by contracts for supplies and services to be made by advertising, except when a public exigency exists; prescribe the mode of advertising for supplies and contracts, and direct that no person shall be received as a contractor "who is not a manufacturer or regular dealer in the articles which he offers to supply."

A person to be a regular dealer, within the meaning of the law, [illegible] be regularly engaged in the business of buying the articles and sel[illegible] the same to the general public, and not merely engaged in the busi[illegible] of selling such articles to the Navy Department.

You will please conform strictly to the provisions of the [illegible] statutes, and require conformity thereto from all persons acting u[illegible] your command or direction.

Very respectfully,

WM. E. CHANDLER,
Secretary of the Na[illegible]

Chief Constructor T. D. WILSON, U. S. N.,
Chief of Bureau of Construction and Repair.

(The foregoing was also sent to the chiefs of Bureaus of Yards and Docks, Equipment and Recruiting, Navigation, Ordnance, Medi[illegible] and Surgery, Provisions and Clothing, and Steam Engineering.)

NAVY DEPARTMENT,
Washington, February 4, 1884.

SIR: Referring to the Department's letter of December 10, [illegible] attention is called to the fact that there is no rule of the Depar[illegible] allowing purchases to be made in violation of sections 3709, 3718, and 3722, where the amount does not exceed $500. If any such definit[illegible] were to be adopted, then by splitting up orders the law could be [illegible] ually nullified. Where the public exigency actually exists purch[illegible] without advertising or competition may lawfully be made, without [illegible] gard to amount.

Where a purchase of supplies needed for immediate use is so [illegible] that advertising would cost more than could possibly be saved by [illegible] petition the exigency might be deemed to exist. But it will be s[illegible] that even a petty purchase cannot be made after actual competition. Any departure from the strictest letter of the law must be judged by itself, according to the special circumstances, and the character [illegible] position of the officer making or directing the purchase.

Very respectfully,

WM. E. CHANDLER,
Secretary of the [illegible]

(The foregoing was sent to the chiefs of Bureaus of Yards [illegible] D[illegible] Equipment and Recruiting, Navigation, Ordnance, Construct[illegible] Repair, Medicine and Surgery, Provisions and Clothing, and Ste[illegible] gineering. It was sent also to the commandants of the navy-y[illegible] shore stations, and to the navy pay offices.)

TREASURY DEPARTMENT,
FOURTH AUDITOR'S OFFICE,
July 3, 1884.

SIR: The recently discovered frauds in the Bureau of Medicine and Surgery, and the comparison and investigation of the vouchers and entries representing the purchases by the other Bureaus of the Navy Department, which is now in progress, show the necessity, in my opinion, of some changes in methods and forms pertaining to the accounts

bl :s now in use. I think that the blanks generally in use for purchases" have been shown to be both insufficient and danger- in that they bear only the signature of the Chief of the Bureau as ant that all the requirements of the law and regulations have c plied with, including purchase after advertisement and at oid, delivery, inspection, &c. I am in hopes that a uniform blank ner may now be adopted for all the Bureaus, which shall contain a k for the signature of the proper officers charged with the various s pertaining to purchase, receipt, and inspection of supplies; which shall not be considered a perfect voucher until it has received the oval of the Chief of Bureau, after all the subordinate signatures have been affixed. Such a form, if adopted, would be a combina- of the "yard bill" and "Bureau bill," similar to Form No. 1 of the u of Steam Engineering now in use.

ould respectfully suggest that steps be taken to insure a consulta- to this end between the Navy Department and the accounting offi-

n this connection, I beg to call your attention to the third paragraph section 273, Revised Statutes, which requires the Second Comptroller report to the Secretary of the Navy the official forms to be issued in different offices for disbursing the public money in the Department Navy.

Very respectfully,

CHARLES BEARDSLEY,
Auditor.

Hon. WM. E. CHANDLER,
Secretary of the Navy.

TREASURY DEPARTMENT,
FOURTH AUDITOR'S OFFICE,
July 3, 1884.

R: Some months ago I gave directions for an examination of hers in this office and the preparation of a statement which should the total of supplies for the naval establishment paid for at the y pay offices during the fiscal year 1883. This statement has re- ly been completed. It appears that the total of payments was 93,857.37, divided as follows:

ured under contract	$685,352 09
en purchase	1,096,835 36
t from contract or advertisement	511,669 92

details show the purchases of different Bureaus, the payments erent offices, the amounts purchased of individuals and firms, and interesting facts, which I shall be pleased to lay before you, should so desire.

Very respectfully,

CHARLES BEARDSLEY,
Auditor.

Hon. WM. E. CHANDLER,
Secretary of the Navy.

NAVY DEPARTMENT,
Washington, July 12, 1

SIR: I have to acknowledge the receipt of your letter of July : the amount of supplies furnished the naval establishment thı naval pay offices during 1883.

The large proportion of open purchases has been called to tion of the chiefs of the Bureaus, and I shall be glad to e: detailed statement at the first convenient opportunity.

Very respectfully,

WM. E. CHANDLER,
Secretary of

CHARLES BEARDSLEY,
Fourth Auditor of the Treasury.

[Circular letter.]

NAVY DEPARTMENT,
Washington, July 12, 1

SIR: You are requested to again carefully consider the chases of supplies for the Navy under sections 3709, 3718, Revised Statutes, and the two letters of the Department o the same dated December 10, 1883, and February 4, 1884.

By a letter from the Fourth Auditor to the Department, 1884, it appears that during the fiscal year 1883 there were supplies by the naval pay offices:

Under contracts	
Open purchases	1
Exempt from contract or advertisement	ui
Total	2

It does not seem that the public exigencies could have r large a proportion of open purchases.

After having given the subject renewed attention, you will to conduct your official business in strict accordance with law : ulation, and will correct any erroneous practices which may h vailed. No departure from legal requirements can be justified b ing old usage or the custom of your predecessors in office. 1 must be your only guide, and you must accept personal r for the performance of duty in strict accordance therewith.

Very respectfully,

WM. E. CHANDLI
Secretary of

(The foregoing was sent to the chiefs of Bureaus of Yards d Equipment and Recruiting, Navigation, Ordnance, Constr Repair, Medicine and Surgery, Provisions and Clothing, ı Engineering.)

NAVY DAPARTMENT,
Washington, July 12,

SIR: Your attention is called to a letter of the Fourth Audito Treasury to this Department, dated July 3, relative to the ı some change in methods and forms pertaining to the acc blanks now in use for the purchase of supplies and the disl naval moneys.

You are requested at an early date to ascertain the opinions of the rth Auditor, and also to confer with the Second Comptroller with riew to the adoption of the best and safest possible forms to be issued vouchers for disbursements, in accordance with section 273 of the rised Statutes.

Very respectfully,

WM. E. CHANDLER,
Secretary of the Navy.

(The foregoing was sent to the chiefs of Bureaus of Yards and Docks, nipment and Recruiting, Navigation, Ordnance, Construction and r, Medicine and Surgery, Provisions and Clothing, and Steam Enering.)

NAVY DEPARTMENT,
Washington, July 12, 1884.

SIR: I have to request that you will at an early date confer with the fs of the Bureaus of this Department, either with each separately at a meeting of all, with a view to the adoption of the best and safest ble forms to be issued for vouchers for disbursements of the public y in this Department. When you have done so I desire that you u revise all the forms now in use and report to me any changes med advisable by you in the official forms to be issued, or in the ner and form of keeping and stating the accounts of the persons ployed in this Department, in accordance with paragraph 3 of section 3 of the Revised Statutes.

Very respectfully,

WM. E. CHANDLER,
Secretary of the Navy.

Hon. W. W. UPTON,
Second Comptroller of the Treasury.

TREASURY DEPARTMENT,
SECOND COMPTROLLER'S OFFICE,
Washington, D. C., July 15, 1884.

SIR: I have the honor to acknowledge the receipt of your letter of the i instant requesting me to confer with the chiefs of Bureaus of your partment at an early date, "with a view to the adoption of the best the safest possible forms to be issued for vouchers for the disbursent of the public money" in your Department, and stating that when 'e done so you desire that I "will revise all the forms now in use," report to you any changes deemed advisable in the official forms to , or the manner and form of keeping and stating the account tne rsons employed in this (your) Department, in accordance with . 3 oi section 273, of the Revised Statutes.

I shall take pleasure in conferring with the chiefs of Bureaus as rested, at any time that it may be most convenient, either separately a meeting of all, for the purposes indicated by you, and in coming with your request in all respects.

Very respectfully,

W. W. UPTON,
Comptroller.

Hon. WM. E. CHANDLER,
Secretary of the Navy.

NAVY DEPARTMENT,
Washington, July 16,

SIR: I have the honor to acknowledge the receipt of your the 15th instant, in reply to that of the Hon. Secretary of the the 12th instant, with reference to a conference with the chiefs of of this Department, upon the subject of forms, &c., and the transacting business.

I have this morning had a consultation with the chiefs of the of the Navy Department, and would respectfully suggest tl y us in a body, either to-morrow or Friday, in the office of of the Navy, at such hour as may be most convenient to yo

This course is suggested for the reason that here are our for &c., at hand, more convenient to refer to or produce than i obliged to carry them to the Treasury Department.

I will be glad to have a line from you as to what your pleasure in the matter.

Very respectfully,

ED. T. NICHOL
Acting Secretary of the

Hon. W. W. UPTON,
Second Comptroller of the Treasury.

NAVY DEPARTMEN
Washington, December 4,

SIR: Please inform this Department whether there is any obj having all certificates in settlement of naval accounts, which ar by the Fourth Auditor and Second Comptroller of the Treasur mitted to the Secretary of the Navy before payment; the sa forwarded by him to the persons to whom payment is due.

Very respectfully,

WM. E. CHANDLE
Secretary of the

Hon. W. W. UPTON,
Second Comptroller.

NAVY DEPARTMEN
Washington, December 4,

SIR: Please inform this Department whether there is any obj having all certificates in settlement of naval accounts, which ar by the Fourth Auditor and Second Comptroller of the Treasur mitted to the Secretary of the Navy before payment; the sam forwarded by him to the persons to whom payment is due.

Very respectfully,

WM. E. CHANDL
Secretary of the

Hon. CHARLES BEARDSLEY,
Fourth Auditor.

TREASURY DEPARTMENT,
SECOND COMPTROLLER'S OFFICE,
Washington, December 6, 1883.

SIR: I have the honor to acknowledge the receipt of your letter of 4th instant, inquiring "whether there is any objection to having all ates in settlement of naval accounts, which are issued by the rth Auditor and Second Comptroller of the Treasury, transmitted Secretary of the Navy before payment."

In reply I have respectfully to say, my view of the law leads me to conclusion that there is no legal or valid objection to that course. n unable to see that any serious inconvenience either to the officers Government can arise from certifying all balances of accounts ng in the Navy Department to the Secretary of the Department, required by section 273 of the Revised Statutes.

I think it must be admitted that certifying a balance to any other of- or person in place of transmitting the certificate to the head of the tment is not, in strictness, such compliance with the statute as r der the certificate in all respects operative as a decision, the duty t certifying officer not being terminated until the certificate issues m the office where it is made, and his acts not being effective unless e in the mode authorized. An equally important consideration is t the practice of certifying balances to some other officer, and not to Secretary, substantially removes the claims from the operation of important provision of section 191 of the Revision in regard to re- ning cases for review.

Very respectfully,

W. W. UPTON,
Comptroller.

Hon. WM. E. CHANDLER,
Secretary of the Navy.

TREASURY DEPARTMENT,
FOURTH AUDITOR'S OFFICE,
December 7, 1883.

SIR: Your letter of the 4th instant, in which you request me to in- n the Department whether there is any objection to having all cer- ates in settlement of naval accounts, that are issued by the Fourth itor and Second Comptroller of the Treasury, transmitted to the tary of the Navy before payment, the same to be forwarded to the s to whom payment is due, has been received.

question is submitted without suggestion as to the advantage is expected to follow, or the object to be attained from a departure n the existing practice. I accordingly reply that the adoption of course contemplated is open to very serious objections, among which be mentioned the following:

First. It would change a mode of doing business in the Treasury De- ment, which has been in successful operation for more than fifty s.

co ly. It would introduce a new and different method from that in other auditing offices of the Treasury, and thus interfere uniformity and harmony now existing.

rmy. It would retard the dispatch of public business, increase l expense, and be likely to lead to confusion and uncertainty mi of claimants as to the place of settlement of their accounts yment of their claims.

Fourthly. It would interfere seriously with the keeping of recor this office, now kept in accordance with settled methods based present practice. From the time the first inquiry in relation to a is received until final adjustment every step is noted, and whe certificate is forwarded to claimant the history of the case is com and, even beyond this, inquiries frequently arise in reference to settlement of accounts, where the payment has, from accident or cause, been delayed, which it would be impracticable to either pr or satisfactorily answer if the proposed change were adopted.

Fifthly. It would impose hardships upon many needy claimant can now have their claims for small amounts settled in two or hours, whereas if such claims must take the usual course throug Departments, an equal number of days, or even a longer time, wo required. Such cases are occurring constantly where enlisted me ply in person for little balances due them as wages, clothing, or money, and to whom it is often important that they should receiv small amounts with as little delay as possible.

There are other good reasons why the present practice should n changed, but it is presumed the above will be sufficient.

Very respectfully,

CHARLES BEARDSLEY,
Au

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy.

MEMORANDUM BY THE SECOND COMPTROLLER IN REGARD TO PAYMENT OF ACCOUNTS AND CLAIMS ARISING IN THE NAVY PARTMENT.

The powers of the Auditors and Comptrollers in the settlement of counts and claims and in certifying balances are conferred and by section 277 and sections 268 to 275 inclusive of the Revised and it is safe to say there is no other provision of statute that manner modifies or changes the modes there presented of set counts and transmitting the certificates of settlement from or Department to another.

For the purpose of this memorandum it is not necessary to an examination of the mode prescribed for other officers than th Second, Third and Fourth Auditors, and the Second Comptro

Section 277 empowers and requires the Auditor to exami counts, of the kinds designated as within his jurisdiction, that, "After examination of such accounts, he shall certify the and transmit such accounts with the vouchers and certifica Second Comptroller for his decision thereon."

From this provision of the statute which defines the dutie Auditor and is the exclusive basis of all his official power in this it is clear that he is not required to examine any account of not required to certify the balance and transmit the certifi Second Comptroller.

It is equally plain that that which is to be transmitted by the to the Comptroller for decision is not a matter that can be the Auditor. Section 273, which confers and defines the power Second Comptroller in relation to such accounts, makes it his duty

nine all accounts settled by the Second, Third, and Fourth Auditors, certify the balances arising thereon to the Secretary of the Depart- n which the expenditure has been incurred." This explicit lan- puts it beyond question that the Comptroller is required to cer- the balance to the Secretary of the proper Department in every in which he is required to examine an account, and the Comp- er's duty in regard to an account of this kind is not performed l the balance is certified to the head of the proper Department. s the accounting officers are created by statute, and have no powers pt those conferred by statute, all their attempted official acts are unless done in the manner prescribed by statute.

actice three modes of payment are resorted to, namely: 1st. called payment by report, or in report cases, in which the ac- is regularly audited and the certificate or report transmitted to the etary, in strict compliance with the statute, before payment. 2d. is called payment by certificate or certificate cases, in which the tor and Comptroller issue their certificate, declaring what balance le, but transmit the certificate to a disbursing officer for payment out actually submitting it to the Secretary; and 3d. Payment by dis- officers before the account of claim is examined by the account- cers. In the cases last mentioned money is drawn from the Treas- n pursuance of section 3673 of the Revised Statutes and placed in the ls or to the credit of a disbursing officer, for the payment of such cur- expenses as are so clearly due, and in such certain sums that it is rea- le to require a disbursing officer to pay them before the respective ns are audited. This mode of paying current expenses is clearly orized, and seems to be indispensable to the convenient transaction iblic business. It does not necessarily include the payment of stale oubtful claims, but in the course of business doubtful claims will sionally be presented to disbursing officers; old claims are sometimes presented, and disbursing officers, doubting their authority to pay ich cases, and being anxious to obtain an opinion or decision of the unting officers in advance of payment, a practice long since grown f referring such claims to the accounting officers for such opinion cision, and out of this has originated the mode of proceeding known certificate cases." As has been before said, the certificates of this differ in no material or substantial respect from those known as s," except in being sent to a disbursing officer for payment, reports are always sent to the Secretary of the Navy for his ac- One of the objections to transmitting the certificate to the dis- ing officer is, that such transmission is not in compliance with a ive requirement of the statute, and the certificate so transmitted e disbursing officer cannot operate to authorize or justify a pay- t except upon the supposititious fiction of its having gone to the Sec- , an assumption which is known not to be true in fact—known to accounting officers, to the claimant, and to the disbursing officer. ther objection is, that such certificates may contain errors, and this e deprives the Secretary of the Navy of all opportunity of return- he certificate for correction, in pursuance of section 191 of the Re- l Statutes, and of all means of pointing out errors in any manner, knowing the nature of the claim until after its payment. The Auditor is charged by section 283 with keeping the public ac- s of the Navy Department, and it has been said he claims to de- power in the settlement of claims. from the third section of the of June 19, 1878 (20 Stat., 167), which treats of a "general ac-

count of advances," and of the adjustment of appropriations, and says "the Fourth Auditor shall declare the *sums due* from the several special appropriations upon complete vouchers, *as heretofore*, according to law; and he shall adjust the *said liabilities* with the "general account of advances." What the supposed authority is, or how it is to be derived from that act, I am not advised, but it is clear that by section 277 of the Revised Statutes the Auditor, *after* examining the accounts and certifying *the balances*, is required "to transmit such accounts with the vouchers and certificate to the Second Comptroller for his decision thereon." And by section 283 he is only to receive back from the Second Comptroller "the accounts which shall have been *finally adjusted*." What he can do with them while the accounts are in the Comptroller's office for decision, or when he again receives the accounts which shall have been finally adjusted, does not appear. It has always been held that after the balance of an account has been duly certified to the Secretary of the proper Department, nothing more is required from the Auditor than to record the requisition, make the proper entries in the book of accounts, preserve and safely keep the papers, and report to the Secretary of the Treasury as required by the same section, 283. Should the Auditor and Comptroller make all these settlements in the mode now in use in what are called "report cases"—that is, in direct compliance with sections 277 and 283, above referred to—I think no inconvenience would result. In that case the Secretary of the Navy would forward to disbursing officers for payment all claims that can more conveniently be paid in that manner, and would issue his requisition for the payment of such as he desires to have paid by warrant drawn directly on the Treasurer. Whether the money is placed in the hands of the disbursing officer or paid to the claimant directly by the Treasurer, the money is drawn from the Treasury in pursuance of section 3673 of the Revised Statutes, which provides that "All moneys appropriated for the use of the War and Navy Departments shall be drawn from the Treasury, by warrants of the Secretary of the Treasury, upon the requisitions of the Secretaries of those Departments, respectively, countersigned by the Second Comptroller of the Treasury, and registered by the proper Auditor." And the money passes from the Treasury by authority of section 305, which provides that "The Treasurer shall receive and keep the moneys of the United States, and disburse the same upon warrants drawn by the Secretary of the Treasury, countersigned by *either* Comptroller, and recorded by the Register, and not otherwise." It has been asserted that section 305 is modified by the provision of section 269 of the Revision, to the effect that it is the duty of the First Comptroller "to countersign all warrants drawn by the Secretary of the Treasury, which shall be warranted by law;" but it will be found that the provision of section 305 is the later enactment of the two, and that if either is modified by the other it is the older enactment that is thus modified, namely, the one now contained in section 269, the verbiage of which remains the same as when enacted, September 2, 1789 (1 Stat., 66), and re-enacted March 3, 1817 (3 Stat., 367).

(NOVEMBER, 1883.)

TREASURY DEPARTMENT,
December 11, 1884.

SIR: Referring to your communication of the 1st instant, requesting that hereafter the name of the pay office be omitted in certificates issued

by the Fourth Auditor in settlement of accounts, and left to be inserted as may be determined by the Navy Department, I have the honor to inclose a copy of the report of the Fourth Auditor in the matter of the 5th instant, for your information.

Very respectfully,

H. McCULLOCH,
Secretary.

Hon. W. E. CHANDLER,
Secretary of the Navy.

TREASURY DEPARTMENT,
FOURTH AUDITOR'S OFFICE,
Washington, D. C., December 5, 1884.

SIR: I have the honor to acknowledge the receipt of a letter of the honorable Secretary of the Navy, dated on the 1st instant, and referred by you to this office, requesting that hereafter the name of the pay office be omitted in the certificates issued by the Fourth Auditor, and left to be inserted as may be determined by the Navy Department.

The change suggested by the Secretary I regard as inexpedient and calculated to produce confusion in the records of this office, and undoubtedly cause unnecessary delay in all cases where facts can now be promptly ascertained; without, so far as I can see, accomplishing any good result.

The accounting officers in making up the certificates designate the disbursing officer by whom they are to be paid, and that for the very purpose of having a complete record. A large majority of the claimants are persons not in service, and the certificates are made payable at places to suit their convenience; the correspondence with such claimants being altogether with this office enables it to so direct the payment. The certificates are returned to this office as vouchers in the accounts of the disbursing officers, and are filed with the account, and at any subsequent time a reference to it will show if the certificate has been paid.

If the request of the Navy Department could be complied with, the accounts of *all* the disbursing officers would have to be examined. The effect would be most pernicious, rendering it almost impossible for the accounting officers to say whether any settled claim had or had not been actually paid.

The present system has worked with great success since the formation of this office in 1817, and to change it now would be highly unwise, and I am sure the evil effects have only to be brought to the attention of the honorable Secretary of the Navy to induce him to change his views.

Very respectfully,

CHARLES BEARDSLEY,
Auditor.

Hon. HUGH McCULLOCH,
Secretary of the Treasury.

CORRESPONDENCE RELATING TO OMISSION BY FOURTH AUDITOR OF THE ORDER OR DIRECTION TO DISBURSING OFFICERS ON CERTIFICATES OF SETTLED CLAIMS TO PAY THE SAME.

NAVY DEPARTMENT,
Washington, D. C., December 1, 1884.

SIR: Upon each certificate of a settled claim issued by the Fourth Auditor of the Treasury, an order or direction of payment is made, naming some particular pay officer of the Navy.

I have the honor to request that hereafter the name of the pay officer may be omitted and left to be inserted as may be determined by this Department.

Very respectfully,

WM. E. CHANDLER,
Secretary of the Navy.

Hon. HUGH MCCULLOCH,
Secretary of the Treasury.

NAVY DEPARTMENT,
Washington, December 13, 1884.

SIR: I have the honor to acknowledge your communication of the 11th instant, inclosing a copy of the report of the Fourth Auditor in the matter of my request of the 1st instant, that the name of the disbursing officer designated to pay certificates issued by the Fourth Auditor in settlement of claims be omitted.

Among the reasons given by the Fourth Auditor in his report, for opposing my request, is that which he first urged in opposition to sending the certificates of settled claims to this Department for payment, viz, that "the present system has worked with great success since the formation of his office in 1817!"

The other objections urged by the Fourth Auditor, relate to the details of office, which can be readily adjusted.

The Second Comptroller, in his communication of December 6, 1883, refers to these minor objections as follows: "I am unable to see that any serious inconvenience to the officers of Government could arise in certifying all balances of accounts occurring in the Navy Department to the Secretary of the Department, as required by section 273 of the Revised Statutes."

I therefore pass over these minor objections without comment.

The statement quoted above, "that the present system has worked with great success," may be true, yet if that system is not in accordance with law it should be changed.

Money is drawn from the Treasury by this Department under section 3673 of the Revised Statutes, which provides that "All moneys appropriated for the use of the War and Navy Departments shall be drawn from the Treasury by warrants of the Secretary of the Treasury, upon the requisitions of the Secretaries of those Departments, respectively."

* * * * * * *

Section 3676 of the Revised Statutes provides that "All appropriations for specific, general, and contingent expenses of the Navy Department shall be under the control and expended by the direction of the Secretary of the Navy."

* * * * * * *

Section 277 of the Revised Statutes provides that "The Fourth Auditor shall receive and examine all accounts accruing in the Navy

artment or relative thereto, * * * * and after examination of accounts he shall certify the balances, and shall transmit such unts, with the vouchers and certificates, to the Second Comptroller iis decision thereon."

ence it appears that the question raised is one of law and jurisdic—a question of prime importance.

ie duty of the Fourth Auditor in certifying balances ceases when he referred them to the Second Comptroller.

rsing officers of the Navy are as clearly within the exclusive iction of this Department as officers of other corps of the Navy.

is not competent therefore for any other Department of the Goviment to issue orders to disbursing officers in the performance of their es, without authority from this Department.

ie direction of the Fourth Auditor to a disbursing officer of the y to pay a claim, is an order which is an infringement of the jurisn of this Department. At times these orders cannot be executed, the certificate would be considered invalidated if a change therein l be made in the direction for payment. Inconvenience and delay in returning to the Fourth Auditor such a certificate for correc-

ay at times be convenient for the Department to designate parofficers for the payment of settled claims, and to make provision r by drawing requisitions accordingly. In such cases the present rates against the exercise of such discretion.

tment is at all times ready to enter upon any arrangement liate public business with the Treasury, but cannot approve a even when ratified by long usage, which contravenes a proor law, and infringes upon its jurisdiction.

Very respectfully,

WM. E. CHANDLER,
Secretary of the Navy.

on. HUGH MCCULLOCH,
Secretary of the Treasury.

No. 21.—NAVY-YARD COMMISSION.

WASHINGTON, D. C., *December* 10, 1883.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy:

SIR: Concurring fully in the report submitted and the views expressed by the commission on the sale of navy-yards, I cannot but express my regret that it placed such a construction upon the law defining its duties as to place a report of facts and an expression of opinion upon various questions connected with navy-yards and navy-yard management beyond its duties; more especially as I feel confident that its recommendations thereon would have been made with the same unanimity as on the questions considered.

I therefore desire to call your attention to some particulars that seem to me worthy of consideration, and trust, in view of the fact that Congress provided that one member should be a civilian, I shall not be considered presumptuous in so doing, my views being offered as those of a civilian only.

The commission has called attention to the deplorable condition of the yards, the disastrous results that have attended the temporary expedients resorted to, and the inferior work performed under the pretense of economy, and has shown that while the aggregate cost of all improvements, repairs included, is $52,574,291.73, the present estimated value is but $31,112,974.91, a depreciation for which no good excuse can be given.

This depreciation does not, however, exhibit the full results of this disastrous policy, for it will be seen by an examination of the tables that a large number of the so-called improvements are of a temporary character, many being unworthy of repair and in such bad condition that though necessarily appraised at a nominal value are in fact unworthy of notice in connection with the permanent improvements of the yard. It must also be stated to complete the record that considerable amounts of money have in times past been expended for improvements and repairs that were not legally available for such purposes, and were not therefore included in the expenditures given, no record having been kept thereof. The actual loss is, therefore, greater than the report would indicate.

The commission also found it in many instances impossible to ascertain the cost of the various improvements they were instructed to appraise, or of the repairs and improvements made to any of them, and was therefore unable to furnish anything more than an approximation thereto. I desire in this connection to call special attention to the importance of subjecting the accounts of the navy-yards to a preliminary examination under the direction of the Secretary before transmitting them to the accounting officers of the Treasury, in order to ascertain, by grouping the expenditures of the various yards and bureaus in a proper manner, the cost of each improvement in every yard, of every ship, and of the repairs

h, in which should be included the proportional expense of main- the yard, as hereinafter explained.

u system would furnish the responsible executive with informa- im(ensable to an intelligent interposition of his authority in time to edy irregularities, or check wasteful or illegal expenditures; whereas s now dependent upon the accounting officers of the Treasury for i information, which for obvious reasons it is impossible for them to ly in time to be of any real and practical value, the much-lauded igh little understood system of "checks and balances" imposed by Treasury resolving itself, when analyzed, into a mere question of ncing the accounts of disbursing officers, which has little or no rela- to the promotion of economy or the prevention of extravagance or , as the records prove. I do not, in making these remarks, desire rage the services rendered by the accounting officers in the per- ce of their important and legitimate duties, but to call attention le llacy of the popular idea that incapacity or dishonesty on the of executive officers can be remedied, prevented, or detected by a examination of the accounts of their expenditures by the account- of another Department, who neither have, nor can have, any ade- e knowledge of the value of the work alleged to have been per- or of the facts in the case, an idea that is not only without ion in fact, but, as the record shows, has enabled dishonest offi- to protect themselves from detection during years of continued s.

commission has called attention to the urgent necessity for more , l to the fact that the use of iron and steel for ship-building nas very greatly increased the necessity therefor, but it has by comparison with the resources of foreign yards how truly inadequate are those of our own, or called attention to the consideration that docks are the only indispensable adjuncts y that cannot be improvised with success, the length of time ir for their construction, which is from three to five years for a e, d from twelve to eighteen months for a wooden dock, render- it i ossible to complete them in case of war in time to be of any ue.

Government possesses to-day but one floating and three stone available for immediate use, of which one requires lengthening, h extensive repairs that they cannot be made on account of t that would be required, so indispensable is the dock to the e of the current work of the yard, though the necessity so great as to imperil the structure. If to these we add the dock now nearly completed at Mare Island and a small marine at the Washington yard, the utmost resources of our navy- fully stated. I cannot, under these circumstances, too strongly nediate commencement of at least one additional dock at u, New York, Norfolk, and Boston, and the construction of idly as possible until there are at least four good docks yards. This may be considered an extravagant recom- n, but in view of the evidence presented to the commission, I that it is reasonable and moderate, and therefore place it on trusting to the future for my vindication. No country, indeed, y pretensions to the name of a naval power, is so poorly pro- appliances for dockage, ample facilities for which are so to the maintenance of an effective navy.

ed is the importance attached to docks in England that has forty-six docks in her home and six in her colonial

yards, she is at the present time constructing several new ones of extraordinary size; and although there are one hundred and eighty-four private docks in the various ports of Great Britain and Ireland, and fifty-four in her colonial ports, the Board of Admiralty are authorized to make advances to parties who will construct new ones in accordance with the requirements of the board, the Government receiving no other return therefor than the right to their use in case of emergency. There are on the other hand in this country but twenty-four private docks on the Atlantic and Gulf coast, two on the Pacific, and twenty on the lakes of sufficient size to dock even a small gun-boat, of which but eight in all are of capacity to receive a first-class cruiser: It would seem therefore well worthy of consideration whether similar authority should not be conferred on the Navy Department.

The attention of the commission was also called to the attempts that have been made to reduce the cost of maintaining armored ships in condition for immediate use in case of war, and it would seem from the information obtained that important steps toward solving this great problem have been taken, by storing them on shore, as an iron ship out of water and housed over should suffer no practical depreciation, or require any great expenditure save for paint, while it would be ready for service at a few days' notice. I therefore earnestly recommend the appointment of a naval board to examine and report upon the methods now in use to accomplish this end, and that in case they deem them successful, and the remedy effectual, immediate steps be taken to construct storage docks or piers for such number of armored vessels as may be deemed requisite to place the Navy in proper and effective condition. I would also urge that immediate steps for the construction of such vessels be taken, for it must be remembered that a first-class armored vessel cannot be built in less than three to five years; that we have in this country no appliances to produce the materials therefor, and that the days when a fleet of frigates and line-of-battle ships fully able to meet their antagonists could be constructed and commissioned in four months and gun-boats in ninety-days, have passed forever. In making this recommendation I have no expectation of meeting the approval of that class of citizens who, while clamoring for "a vigorous foreign policy," are unwilling to appropriate the money necessary for the construction of such a navy as alone can make such a policy possible, but on the contrary scent a job in every estimate, and are apparently never so happy as when denouncing and ridiculing a branch of the public service to which we owe our existence as a nation. It appears probable, however, that the value of an effective navy will not be appreciated by a majority of American citizens until they have learned by sad experience that while an army may "spring from the ground" at a moment's notice, time as well as money is required to create a navy that can meet with the slightest prospect of success the fleets of any great naval power.

The commission has called attention to the defenseless condition of our navy-yards, and the importance of rendering them impregnable at the earliest moment. I desire, in this connection, to call attention to the fact that the plans for such fortifications are in many countries approved and determined upon by mixed boards of military and naval officers, though designed and constructed by military engineers, as here. It seems, under these circumstances, remarkable that no such precautionary measure prevails here, as the fortifications of our yards, unlike those of Europe, are planned for defense against naval attacks only, and especially as our Navy demonstrated its ability to pass in wooden ships with comparative impunity the strongest fortifications our engineers

had been able to devise and the entire resources of the Confederacy to supplement, it would seem well therefore to avail ourselves of the experience of the officers who performed such feats before proceeding with the fortifications of the ports which must constitute the basis of operations of the Navy, and remember that as the strength of such fortifications must, when needed, be tested by naval and not by military officers, their sufficiency should be determined by our naval experts, who are of necessity the highest authorities as to the possibility of a successful naval attack.

The same remarks apply with even greater force to the torpedo system, for it is evident that the Navy must co-operate with the Army in the defense of any of our ports in case of attack. It is equally evident that the torpedoes must be so placed as to enable the Navy to maneuver and act without either danger or the apprehension of danger therefrom, and that the experience of naval officers would enable them to determine the points most liable to attack and protect them accordingly.

The same rule should also be applied to the improvement of harbors, not only on account of the benefits that would accrue from the discussion of the question of tides, currents, and the various questions connected with navigation by naval officers, who know the necessities of the Navy as well as the commercial marine, but for the reason that the surveys upon which the engineer has to depend for his data are made by naval officers detailed for service in the Coast Survey, and who are therefore fully conversant with every fact bearing upon the subject.

These recommendations are not offered as original ideas, being at best but an extension of the system that has proved so beneficial in its application to the business of the light-house establishment, and one that is now in operation in England, where it has met with great favor.

The commission has directed attention to the defenseless condition of our lake ports, and to the fact that England has by means of her canal system, which we have nothing to offset, opened our lakes to the ocean and made their shores, so far as she is concerned, a part of our coast. This being the case, no time should be lost in taking effective measures to place ourselves in a position to offset such overwhelming advantages, by the establishment of a navy-yard on the lakes and the storage of a suitable fleet therein, or the conversion of the Erie Canal into a ship-canal of at least equal capacity to the canals of the Canadian system, or by the establishment of a navy-yard upon the Mississippi River and constructing ship-canals therefrom to the lakes. I therefore most earnestly recommend that a commission be created to investigate and report upon this question in all its phases, and would suggest that the board recommended by the commission to determine the best location of a navy-yard for the Gulf could, with great propriety, be charged with this question also; more especially as both subjects involve the advantages and disadvantages of the Mississippi River as a proper location for a navy-yard, and a base of operations in case of war.

The commission have also called attention to the great desirability of canal communication between the Chesapeake and Delaware, but I would suggest that an investigation on the broader basis of the consideration of the entire question of ship-canals, so far as they may be important factors in the defense of our coasts or for commercial purposes, is of pressing importance.

The commission has called attention to the extravagance and inefficiency of navy-yard management, and to the necessity for a thorough reorganization of the present system of performing work therein; but

has made no other specific recommendations than concentration and consolidation, which, though indispensable, are by no means adequate remedies for all existing evils.

It will be seen by reference to the report that it has cost $26,926,129.12 to maintain the yards for the past fifteen years, and that it was found impossible to ascertain the value of the product of each yard, no records having been kept from which such information could be obtained. I therefore prepared an estimate of the value of the output, based upon the best information I could obtain and upon personal observation. It is, however, an estimate only, and though based upon principles the correctness of which can be demonstrated, it is probable, more especially as I had no data upon which to base deductions for losses and mismanagement in special cases, some of which are notorious, that my allowance of $10,896,521.40 is full, if not somewhat in excess, and that the deficit of $16,029,607.72 which remains is below rather than above the actual amount—a most disastrous result. It remains to be seen to to what causes it is to be attributed.

Prominent among them is unquestionably the general but mistaken idea that the Government cannot perform work as cheaply as private individuals, an idea that tends to lessen exertion and to excuse mismanagement. It is unquestionably true, and for obvious reasons, that the Government must expend in checks, balances, and supervision more money than would be expended for similar purposes in private life, but it is not true that the work itself cannot be executed as cheap, if not cheaper, than by private parties, if competent and honorable officers are placed in charge and given proper authority, for the reason that the construction account in navy-yards is relieved of many expenses that must be met by the private ship-builder who must to the cost of his material and labor add interest on the capital invested, taxes, insurance, office rent, and the estimated depreciation of his plant, all of which are expenditures that are not charged, or fairly chargeable, to the cost of work in navy-yards, for the reason that navy-yards must be maintained whether utilized or not. Still less is it true that the cost of the work is greater when calculated on the basis of the appropriation therefor, as the private builder must also add to the above, repairs of all kinds, dredging, the salaries of superintendents, draughtsmen, clerks, messengers, compensation for his own services, incidentals, &c., all of which being paid for out of special appropriations, are not charged to the cost of construction or repairs as they should be, but to the cost of maintaining the yard. It will, therefore, be seen that there is a very great margin of cost in favor of ship-building in navy-yards, as against a contractor.

But it is claimed that the eight-hour law neutralizes these advantages and makes it cheaper to contract than to build, but this is neither true, nor would it be, even if true, a reasonable, much less a satisfactory, excuse, for the contractor must add for his profits to the total cost of his work, as above stated, a sum that cannot be estimated with fairness at less than 20 per cent. If, therefore, it be admitted that there is a loss of 20 per cent. of labor under this law it is even then but an offset to the contractor's legitimate profit; work should indeed be produced so much below the market price that the difference between cost and value would be equal to the cost of maintenance as above stated, the advantages possessed by the yard being so great. That this can be done, with proper management, when there is a fair amount of work to be performed, is unquestionable, and there is no good reason to doubt that such results have been attained in the Washington yard several times

during the past fifteen years, and also in the construction of many buildings in certain yards, as will be seen by reference to the tables accompanying the report of the commission. The eight-hour law is not therefore the cause of the excessive cost of work performed in navy-yards, but resolves itself upon a full understanding of its operations into a mere question of public policy; being in fact but a refusal of the Government to furnish, by entering into competition, any excuse to contractors for overworking their employés or reducing their wages, in order to compete with the superior advantages that I have shown the Government to possess. The eight-hour law has therefore little or no bearing upon the real merits of the case under discussion.

Another reason is to be found in the fact that the construction and repair of ships are purely mechanical operations, which being performed by civilians who are not amenable to naval discipline should not be hampered or embarrassed by rules and regulations which, though indispensable to the maintenance of naval discipline, are not only inapplicable to civil life but calculated to retard and embarrass the performance of work, and as a natural consequence increase its cost.

I would therefore suggest that the duties of a naval station be separated from those of a naval workshop, and that the mechanical work of the yard be placed under the charge of a superintendent having general supervision and control, the work being performed as at present by representatives of the proper bureau under his direction, a system that is, I am assured, in successful operation in the best foreign yards, where it gives general satisfaction.

Such an arrangement would unquestionably deprive commandants of some petty patronage and possibly cause dissatisfaction for a time, but would, I feel sure, prove satisfactory when tested, as it would give them more real power to protect the interests of the Government than the present system, for they would have a supervisory and reviewing power without responsibility for any other acts than their own, instead of being held responsible for mismanagement of which they are innocent and without power to remedy, as is now not infrequently the case.

All ships returning from a cruise should be, for instance, as is the case in the best foreign yards, placed at once in dry-dock, and thoroughly surveyed under the direction of the commandant, who would thereupon report to the Department her condition, necessity for repairs, &c. Should it be decided to repair her she would be delivered to the superintendent, who upon the completion of the work would return her to the commandant, accompanied by an itemized bill of cost. She would then be resurveyed, and the bills carefully scrutinized, under his direction, after which they should be transmitted to the Department with the report of the Board, accompanied by his approval or disapproval of the manner in which the work had been performed, and the cost of the same. In this manner the commandant could exercise an efficient and intelligent supervision over the work, and the Department, having the benefit of his views and opinions on each transaction at the proper time, could take such action as might be required.

Such a change would also make it possible to separate the expenses of a naval station from those of a navy-yard, and thereby ascertain the actual cost of performing work therein, which is at present practically impossible, as they are burdened with charges that do not properly belong to them, having no connection with the construction or repair of ships or their equipment.

There remains for consideration the question of labor, and especially the mode and manner of employment and dismissals. Much has been

said in regard to the evils of political influence when used to secure the appointment and retention of unworthy men, but very little in regard to personal influence, which is even more objectionable and is unquestionably a far greater evil in navy-yard management. I would therefore suggest the substitution of the words "improper influences" for "political influence," as a more truthful and comprehensive statement of the case. I would also suggest that the evil complained of is not the cause but the result, and that the difficulty can be traced to the lack of proper personal responsibility that at present exists, and will continue to exist, so long as the workman is lost sight of and the employment and discharge of the individual is made a question for the consideration and approval not only of the commandant but the Department itself.

The only effectual remedy is to be found in holding each officer, master mechanic, and foreman personally responsible for the character and cost of the work performed under him, which cannot be done unless they have each in turn the right to select their own subordinates, and to discharge them in case they fail to give satisfaction; just as is done in all well managed private yards. It will doubtless be urged that this will give too much power to subordinates, but the improper use of such power by any person would at once demoralize the force employed under him, increase as a natural result the cost of his work, and thereby compel the removal of such an unworthy person on his record alone. I am therefore unable to see any good grounds for apprehension, more especially as I tested such a system upon the public works under my charge for many years, and found no greater difficulty in producing work at fair rates and of the highest quality than I should under similar circumstances in private life, securing at the same time the hearty co-operation and support of the mechanics and laborers employed.

If, on the other hand, vested rights in public employment is to become the rule, and the employment or discharge of an employé is to be considered a state question, to be investigated by the Department, the sooner the yards are closed or operated under contract the better, as nothing but continued disaster, discord, and failure can possibly be the result. If, on the other hand, the Department will ignore the individual and recognize the workman, knowing him only as worthy or unworthy of his compensation, and will promptly detach or dismiss, as the case may be, any officer, mechanic, or laborer who cannot produce good work at fair rates, and is therefore unworthy of his hire, the yards will become a source of profit instead of loss, and pride instead of reproach—results that competitive examinations and civil service will never attain.

It is evident, as before stated, that the Department can by a proper classification of its expenditures determine the cost of every ship, building, or other improvement, including the repairs thereon to any given date, and that from such a statement the comparative cost of work in the different yards can be readily ascertained. It is not so easy, however, to establish a standard by which to determine the actual market value of the work so performed on the article produced. I have given this subject much consideration, but can suggest no better plan than the construction of a portion of the ships of each type in navy and private yards, making thereby the work performed in the yard a standard of quality, and that under contract, of cost.

Such a system would also be most beneficial in encouraging and developing iron shipbuilding in this country, not only for the commercial advantages that would follow, but for the potent reason that every private ship-yard which is able to construct a war vessel is an addition

to the naval resources of the country, being in fact a reserve yard maintained without cost. This suggestion is not offered as an original idea, as it embodies nothing more than the policy that has been pursued by England for many years under which the number of private yards in Great Britain, able to construct war vessels, has so increased that no less than fifty-two have been duly inspected by the Board of Admiralty and placed on the list of contract yards; several of them having ample appliances for the construction of the heaviest armored vessels. England is therefore able to re-enforce the capacity of her navy yards to an extent beyond the demands of any probable emergency, while there are not in the United States over six private yards that could undertake the construction of a first-class cruiser, and no yard, public or private, that could construct a modern armored ship without importing the armor therefor. Prudence alone would therefore seem to indicate the importance of encouraging private enterprise to extend the capacity and increase the number of ship-yards by every means in its power.

The policy and practice of England not only justifies these recommendations, but demonstrates beyond question that her reasons for constructing so large a portion of her fleets by contract has not been, as generally supposed, from motives of economy, but for the reasons above stated, as will be seen by an examination of the records of her navy from 1860, when the Warrior, the first armored ship of the British navy, was launched, to the present time.

In considering this question, it is, however, necessary to bear in mind that the engines are in no case built in the yard, but by private firms who make the construction of marine engines a speciality, and who submit with their proposals designs which are based upon the conditions specified by the admiralty, accompanied by a guarantee of speed. There are unquestionably many advantages in the system, the most important being the fixing of responsibility for any deficiency in speed or economy and efficiency in the motive power; the designs of the ships being accepted by the contractors as the basis of their estimates; whereas it is under our system a debatable question whether such defects are chargeable to the hull or the motive power, and as a consequence, to the Bureaus of Construction or Steam Engineering. Repairs of machinery, are however, made in England as with us in the yards alone.

From 1860 to 1872 thirty-seven armored ships were launched, of which twenty-five, with a displacement of 149,360 tons, were built by contract, and but twelve, having a displacement of 84,037 tons, in its yards, a proportion of about two to one in favor of contract work. During the next period, from 1872 to 1879, inclusive, a decided change took place in favor of construction in navy-yards, the proportion being slightly in favor of that system; seven ships, with a total displacement of 51,200 tons, being built in navy-yards and six, with a displacement of 43,200 tons, by contract. This change of policy has since then become so marked that out of fourteen armored ships launched and laid down since 1879, but one has been built by private parties.

The policy of England has not, however, been so decided in regard to cruisers, dispatch-vessels, and similar work, though it is decidedly in or of navy-yards. The percentage of all vessels, armored and unred, built in her yards prior to December, 1870, being but thirty-six; from that date to 1881 it increased to seventy-one, and to a much greater degree in the importance of the vessels than in numbers, which seems to indicate a purpose of relying in future upon her own yards, having established ship-building on a basis that leaves nothing more desired. Though it must be admitted that a large number of the

most experienced naval officers and constructors urge the restriction of work in the yards to the construction of ships that are experimental in their design, and to the repairs of hulls and engines, in fact to work that cannot from its nature and character be fully specified before contracts therefor are entered into, believing, that where intelligent competition can be obtained, work can be procured cheaper by contract, it is however, generally conceded that all attempts to make contracts for repairs have resulted unfavorably, and that such work should be performed in Government yards only.

In conclusion, I earnestly recommend the appointment of a commission to investigate and determine what changes are required in navy-yard management and organization to secure efficiency and economy, and what legislation is necessary to restore our commercial marine to the position it once held, to create a demand for home-built ships, and thereby establish an ample and efficient reserve of private ship-yards to supplement in case of emergency any deficiencies in our naval establishment.

Very respectfully,

A. B. MULLETT,
Of Commission.

No. 22.—NECROLOGY, 1884.

NAVAL OFFICERS.

LINE.

REAR-ADMIRAL GEORGE F. EMMONS.

Born in State of Vermont August 23, 1811; appointed midshipman in the Navy, from Vermont, April 1, 1828; placed on retired list August 23, 1873; died at Princeton, N. J., July 23, 1884.

WAR RECORD—*War with Mexico:* Employed on Pacific side, on ship and on shore, in Upper and Lower California; was in several engagements with natives of Pacific islands, while attached to the Exploring Expedition, from 1838 to 1842. *War of* 1861–'65: Captured Cedar Keys, west coast of Florida, Pass Christian, Miss., besides some twenty prizes; battle with a rebel force that was evidently intended to capture the shipping and city of New Orleans, in 1865, in which both were saved; in trenches about Washington in 1864.

REAR-ADMIRAL ALEXANDER MURRAY.

Born in State of Pennsylvania January 2, 1818; appointed as a mid- [illegible]n in the Navy, from Pennsylvania, August 22, 1835; retired, on [illegible]own application, after forty years' service, April 30, 1878; died at [illegible]ington, D. C., November 20, 1884.

[illegible] RECORD—*War with Mexico:* Alvarado, Tabasco, Tuspan, Point [illegible] Vera Cruz. *War of the Rebellion:* Repulse of rebel steamer York- [illegible]n off Newport News, in September, 1861; battle of Roanoke Island [illegible]ruary 8, 1862; battle of Elizabeth River, with the Fort and Lynch's February 10, 1862; battle of Newbern, N. C., February 14, 1862; [illegible]le of Winton, N. C.; commanded naval force at battle of Kinston, [illegible]., January, 1862; commanded a military and naval expedition up York and Pamunkey Rivers, which destroyed 27 vessels, approach- [illegible] within 11 miles of Richmond, May, 1862.

COMMODORE T. A. HUNT.

[illegible] in the State of Connecticut July 23, 1805; appointed a midship- [illegible] in the Navy, from Connecticut, February 1, 1825; placed on retired [illegible]y 23, 1877; died at New Haven, Conn., January 21, 1884.

COMMODORE F. B. ELLISON.

[illegible] the State of New York August 15, 1803; appointed a mid- [illegible] the Navy, from New York, May 28, 1819; placed on retired [illegible] 1, 1864; died at Boston, Mass., January 25, 1884.

[illegible]ORD—*War of the Rebellion:* Commanded the U. S. S. Rich- [illegible]e combined attack on Fort McRae, on November 22, 1861.

COMMODORE ROBERT HANDY.

[illegible] State of Rhode Island; appointed an acting midship- [illegible]y February 1, 1826; placed on reserved list September [illegible] [illegible]red to active list as a commander September 14, 1855;

placed on retired list February 6, 1862; died at Jamaica Plains, Mass., June 7, 1884; total sea service, 17 years 11 months; total time in the Navy, 58 years 4 months.

WAR RECORD—*Mexican war:* Monterey.

COMMODORE T. S. FILLEBROWN.

Born in the District of Columbia August 13, 1824. Appointed a midshipman in the Navy, from Maine, October 19, 1841; died at New York September 26, 1884.

WAR RECORD—*War with Mexico:* Was present at all the operations on the Gulf coast during the war of 1846–'47 under Commodore Perry. *War of* 1861–'65: Commanded Passaic operating against Fort Sumter, May, 1864; commanded Montauk against Battery Pringle in the Stono River, South Carolina, July, 1864; February 9, 1865, engaged rebel batteries on the Wadmelow and Tagado while in command of the Sonoma.

CAPT. DOMINICK LYNCH.

Born in the State of New York November 2, 1813; appoin midshipman in the Navy February 2, 1829; placed on reserved September 13, 1855; transferred to retired list April 4, 1867; restor to active list, January 20, 1871; retired at his own request January 3 1872; died at Brooklyn, October 10, 1884.

WAR RECORD—*War of Rebellion:* Rescued an American ship from an attack of field batteries, in Lynn Haven Bay, October, 1861; capture of Fort Macon April, 1862.

COMMANDER SAMUEL MAGAW.

Born in the State of Pennsylvania; appointed an acting midshipman from Pennsylvania, November 23, 1841; placed on the retired list October 29, 1868; died at Washington, D. C., May 19, 1884.

WAR RECORD—*War with Mexico:* Naval battery at siege of Vera Cruz. *War of* 1861–'65: Fifteen skirmishes on the Potomac and Rappahannock, in command of boat, co-operating with Generals Hooker and Burnside.

COMMANDER S. DANA GREENE.

Born in the State of Maryland February 11, 1840; appointed an acting midshipman in the Navy, from Rhode Island, September 21, 1855; died at Portsmouth, N. H., December 11, 1884.

WAR RECORD—*War of Rebellion:* Executive officer of the Monitor during the famous action with the Merrimac, March 9, 1862; succeeded to the command upon Captain Worden becoming disabled; also, in the engagement at Fort Darling, James River, May 15, 1862.

LIEUT. BLOOMFIELD M'ILVAINE.

Born in the State of Pennsylvania; appointed an acting midshipman in the Navy, from Pennsylvania, October 9, 1862; graduated from the Naval Academy June, 1866; was placed on retired list November 28, 1883; died at Philadelphia, Pa., April 16, 1884. Total sea service, 7 years 3 months. Total time in Navy, 21 years 6 months.

LIEUT. C. W. CHRISTOPHER.

Born in the State of Ohio November 1, 1847; appointed an acting midshipman February 24, 1863; graduated from Naval Academy in June, 1867; retired from active service September 19, 1882; died at Harbin Springs, California, January 7, 1884.

LIEUT. JOHN P. J. AUGUR.

Born in the State of New York, March 31, 1852; appointed a midshipman in the Navy September 25, 1866; graduated from the Naval Academy June, 1870; died at New York January 9, 1884.

ENSIGN F. W. BOWDEN.

Born in the State of Texas January 16, 1858; appointed to the Naval Academy September 24, 1875; graduated in June, 1882; died on board U. S. S. Trenton, on Asiatic station, June 24, 1884.

MEDICAL DIRECTOR GEORGE W. CODWISE.

Born in West Indies; appointed an assistant surgeon in the Navy, from New York, May 14, 1825; placed on retired list April 30, 1861; died at Wellesley Hills, Mass., May 2, 1884.

PASSED ASSISTANT SURGEON C. E. BLACK.

Born in the Province of New Brunswick July 24, 1846; appointed an assistant surgeon in the Navy, from Pennsylvania, November 14, 1871; drowned on the sinking of the Tallapoosa August 21, 1884.

ASSISTANT SURGEON J. D. SMITH.

Born in New Hampshire April 9, 1822; transferred from the volunteer service to the retired list of the Regular Navy under act of Congress of February 15, 1879; died at Bridgewater, Conn., April 26, 1884.

PAY DIRECTOR JOHN S. GULICK.

Born in the State of New Jersey May 14, 1817; appointed a purser in the Navy February 1, 1851; retired May 14, 1879; died at Princeton, N. J., November 6, 1884.

WAR RECORD—*War of the Rebellion:* Hatteras Inlet, Port Royal.

PAY DIRECTOR A. A. BELKNAP.

Born in the State of New York August 7, 1813; appointed a purser in the Navy, from New York, March 11, 1851; retired January 27, 1873; died at Warwick, N. J., March 14, 1884.

PAY INSPECTOR G. L. DAVIS.

Born in the State of Massachusetts August 10, 1823; appointed a paymaster in the Navy April 16, 1861; retired January 17, 1871; died at Brooklyn December 3, 1884.

WAR RECORD—*War of the Rebellion:* Capture of privateer Savannah; passage of the Pensacola down the Potomac January 12, 1862; capture of New Orleans.

BOATSWAIN JAMES WALKER.

Born in the State of Massachusetts November 12, 1809; appointed a boatswain February 11, 1851; retired November 13, 1871; died at Everett, Mass., May 21, 1884.

BOATSWAIN G. R. WILLIS.

Born in the State of Maine December 20, 1842; appointed a boatswain, from Massachusetts, October 25, 1878; retired September 19, 1882; died at Worcester, Mass., December 7, 1884.

GUNNER FELIX CASSIDY.

Born in the State of Massachusetts; appointed an acting volunteer gunner November 8, 1862; transferred to the Regular Navy as a gunner October 23, 1863; died at Chelsea, Mass., June 8, 1884.

GUNNER S. D. HINES.

Born in the State of Virginia February 27, 1834; appointed a gunner in the Navy, from Pennsylvania, June 10, 1861; retired November 5, 1883; died at Edenton, N. C., October 25, 1884.

CARPENTER CHARLES J. BOARDMAN.

Born in the State of Massachusetts September 21, 1806; appointed a carpenter in the Navy, from Massachusetts, August 23, 1833; retired September 21, 1868; died at Boston December 2, 1884.

CARPENTER JOHN J. THOMAS.

Born in the State of Virginia; appointed as a carpenter in the Navy, from Virginia, April 20, 1874; May 2, 1884, placed on the retired list; died at Washington, D. C., June 23, 1884.

SAILMAKER J. A. BIRDSALL.

Born in New York February 28, 1823; appointed a sailmaker, from New York, March 7, 1848; died at Kittery, Me., July 8, 1884.

WAR RECORD—*War of Rebellion:* On board New Ironsides, 1863–'64.

MARINE CORPS.

MAJ. GEORGE BUTLER.

Born ——, January 23, 1839; appointed February 11, 1859; died February 23, 1884, at Portsmouth, N. H. Total sea service, 6 years 3 months; total service in Marine Corps, 25 years.

WAR RECORD—*War of* 1861–'65: Fort Fisher.

FIRST LIEUT. DAVID WHIPPLE.

Born ——, May 26, 1851; appointed May 29, 1871; died 1 1884, at Norfolk, Va. Total sea service, 4 years 3 months; to in Marine Corps, 12 years 9 months.

No. 23.—PROMOTION IN THE NAVY.

Table showing the effect of proposed legislation on promotion.

Grades.	Number in each grade.	Number of years' service in each grade.	Age at which promoted to—	Number promoted each year to—	Percentage of casualties each year	Increase or decrease in number in each grade in comparison with present law.
.....	150	5	22	33.0	3.3	—28
ant	290	12	27	29.0	3.0	—35
ant-Commander	127	7	39	20.0	3.0	+58
der	90	6	46	16.0	3.0	— 5
.....	50	5	52	10.6	3.3	— 5
ore	.....	.....	.....	.....	.....	.....
imiral	10	5	57	3.6	4.5	.....
imiral	6		.....	.....		.....
al	723	40	.....	.....	.....	.....

No. 24.—BUREAU OF ORDNANCE.

BUREAU OF ORDNANCE, NAVY DEPARTMENT,
Washington City, November 1

SIR: I have the honor to submit the annual report of this and also to transmit estimates for the fiscal year ending June 30,

1.	Fuel, tools, material and labor, small-arms, machine guns, batteries of the new type for four third-rate ships now in service; establishment of a proving and ranging ground; modern armament of two practice ships for the training squadron and for proof of naval guns and appendages	$656,
2.	General repairs to ordnance buildings, magazines, and appendages.	16,
3.	Freight and miscellaneous expenses	5,
4.	Civil establishment at navy-yards	11,
5.	General expenses of the Torpedo Station and purchase of a torpedo-boat, &c	115,
6.	To supply the ordnance outfits of the monitors Puritan, Terror, Miantonomoh, Amphitrite, and Monadnock	1,073.
7.	To continue the development of type guns for the Navy	310,
8.	Main and secondary batteries for the New York	300,
9.	Armament of the twelve new vessels proposed by the Navy Department	1,701,
		4,388,

CANNON.

TYPE GUNS.

In prosecution of work on type guns for the Navy, the first was completed February, 1884, and was sent to the Naval Proving Ground, Annapolis, Md., with several gun-carr ferent patterns, and a quantity of cast-iron shells having ro of various diameters.

All the carriages performed well and demonstrated their sustain the shock of discharge of high-power 6-inch guns.

The shells, as a rule, performed satisfactorily, and one c showed great smoothness of flight on the trajectory (with m uniform action in the bore), was selected as the service ty inch caliber common shell. (See Appendix, report of Lieut. W. M. Folger, which also shows the trajectory of the first 6-inch on the Dolphin.)

The gun has thus far been fired 150 rounds with charges of one-half the weight of the projectile.

It has been frequently and carefully examined and star no defect has yet been discovered in it. The principal compression slope, being about .018 inch on the radius.

It is considered that the general features of construction this piece are suitable for service high-power hooped gu caliber.

In the matter of powder, the Bureau has been working up the proper lensity and size of grain for the 6-inch caliber.

Some classes have shown want of uniformity in results, but others lave done very well, and it is thought that perfectly satisfactory specilcations may soon be fixed upon.

A quantity of German cocoa (or brown prismatic) powder was purhased by the Bureau from the manufacturers in Germany, and was nrought over by the U. S. S. Powhatan. It has given very promising results in the 6-inch gun.

It having been found that steel tubes and jackets for the 8-inch high-power guns could not be produced in the United States, the Bureau was obliged to buy some abroad for the new cruisers.

One gun will be pushed forward as rapidly as possible for trial as a The general design* is the same as that of the 6-inch gun before ioned.

Owing to the delay of the contractors in delivering the hoops for the i h caliber, the construction of the type gun has been very much ayed.

The hoops have now been delivered, and as rapid progress as possie is being made in their treatment and preparation to go on the gun.

The 10 inch, 10½-inch, and 12-inch high-power hooped guns have been ned since last report, and longitudinal sections of them will be found nded. (The guns of lower caliber than these were illustrated in year's report.)

These new guns will be all somewhat longer in the bore than the cal- s heretofore designed, and are expected to develop more power tively. The weight of the shot is to be 500, 550, and 850 pounds, u that of the charge 250, 275, and 425 pounds, respectively.

The data for a 16-inch hooped gun are collected, and it is expected that computations for the design will shortly be made.

Considerable progress has been made towards the construction of a wire-wound gun of 6-inch caliber on the design appended to last year's report.

The Bureau has unfortunately been unable as yet to obtain any high- wire of American material and manufacture. Considerable ex- e with different kinds of wire has, however, been acquired, and sufficient amount of tolerable quality was purchased and is being d on the type gun.

is wire is laid with varying tension, and the calculated resistance of piece to tangential rupture is equal to that of the hooped gun, while it weighs about 1,000 pounds less. (See Appendix, page 431.)

This design of a 12-inch wire-wound gun has been commenced.

Gun-wire of high grade and in very long pieces is made by several firms in England, and there is apparently no practical difficulty in its manufacture, and no reason (except the absence of drawing machinery of sufficient power) why it should not be made in the United States. The calculations involved in the work of designing the type guns were made by Ensign Philip R. Alger, U. S. Navy. Those for the application of gun-wire with varying tension are exceptionally intricate. The services of this young officer have been very valuable to the Bureau.

While proving great guns, the Bureau has tried several new forms of spring-firing apparatus. Two of these promise very well, and will be attached to the guns of the new cruisers.

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*For drawing of the 8-inch guns, see appendix to report of Bureau of Ordnance for fiscal year ending June 30, 1883.

The steel vent-closing primer to go with the apparatus is of peculiar form and has thus far given entire satisfaction.

Two forms of electric vent-sealing primers have also been designed and promise well.

All these will be found figured and described in the Appendix, pages 437, 438, and are due to Lieutenant-Commander Folger and Lieuts. Bradbury and Fiske, U. S. N.

GAS CHECKS.

As a result of experience on the proving-ground, appendages and attachments for working service-breech plugs by hand have been designed for all calibres to 10 inch inclusive. Drawings of the various forms of closure will be found in the Appendix, page 438, and following. These details have been largely worked up by Lieut. A. R. Conden, U. S. N.

The breech-plugs of the heavier guns will be worked by hydraulic power as usual.

In the course of the proof of the 6-inch gun extensive trials have been had of the De Bange gas check. For some time the results were not very satisfactory. The apparatus checked gas well, but stuck so hard in its seat that it was very difficult to withdraw, and the rings that depressed the pad cut the latter badly at high chamber pressures.

These difficulties seem to have been overcome, and the form of gas check now used (which is inclosed by steel rings instead of bronze and tin) works admirably, one man opening the breech of the 6-inch gun (after firing large charges) without difficulty. An account of the forms of check and rings used, with drawings, will be found in the Appendix, page 439.

GUN CARRIAGES.

A type of carriage for the broadside guns of the new cruisers and also for general service has been finished and has given very good results at the Proving Ground.

It is built of steel and is of the gravity return type with hydraulic recoil-check, arranged to maintain constant pressure in the cylinder.

Previous to the construction of this type, two other designs were built, one to run in and out by fluid pressure conveyed from an accumulator below the water line, and the other to run out by hydro-pneumatic action. They both performed very well, but are not quite as convenient and simple as the form adopted for the cruisers.

Several designs for training by fluid pressure were also completed; but it was evidently inexpedient to place them upon so small a carriage as that for the 6-inch gun.

Designs for the 8-inch carriages of the Chicago, Atlanta, and Boston have also been completed and part of the material ordered and some delivered.

Drawings of the carriages of the new cruisers will be found in the Appendix. The details of this work are largely due to Lieut. B. H. Buckingham, U. S. N., who also designed the tower mounts for Hotchkiss revolving cannon to be carried by these vessels.

Drawings of the carriages that are operated by fluid and hydropneumatic pressure are also given in the Appendix.

The designs for gun-carriages of monitors have been very much advanced and can soon be completed.

se carriages are to work by hydraulic pressure and will be accom- by loading apparatus, which works by the same power.

above-mentioned carriages (except that for turret guns) are ged to carry simple inclined steel shields.

PROJECTILES.

Cast-iron common shell with copper rotation bands have been designed for all classes of guns. Those fired from the 6-inch gun have performed very satisfactorily as before mentioned.

A number of steel common shell have been cast and will be proved oon as practicable.

nel have been designed for the 6-inch B. L. R. and also for the L. R. A number of the latter have been manufactured and soon fired.

n matter of armor-piercing projectiles, considerable progress been made. Six-inch steel shells of various physical characteristics been fired against armor plates and a limit of quality has been below which it is useless to go. Furthermore, the shades of for head and cylinder of such projectiles have been sufficiently nted upon to indicate a temper very near to that which will ly be found most effective in service.

form of head has also received much attention, and several es have been tried; one of them proposed by Lieut. Commander lger promises good results against vertical or moderately inclined r. For work against armor very much inclined the flat head seems far to be the most effective.

of these experiments have been carried on with pieces of small wer, such as the high-power musket, the revolving cannon and the h B. L. Howitzer.

ne different forms of head, ogival, trifaced, stepped, flat, &c., will nd figured in the Appendix, page 441, accompanied by the detailed rts.

sides the practice against soft steel plates, very important trials e been had from the Hotchkiss revolving cannon against compound hard-faced plates, using the trifaced tempered projectiles. The rt will be found in the Appendix, page 443.

performance of the projectiles was very satisfactory, and the ice will be repeated on a larger scale as soon as possible.

MACHINE GUNS.

Quite recently the Hotchkiss 57^{mm} and 47^{mm} single-shot guns men- d in the last report have been received. They will be sent to the Ordnance Proving Ground for trial.

s of this type will make a notable addition to the power of naval nts. They are capable of being fired in ordinary service from lve to fifteen times a minute, and the projectiles, having a high velo- ity, are effective against all unarmored ships, and are reported to pene- rate from four to five inches of soft steel (placed normally) at short ange.

The number of machine cannon mounted on foreign vessels of war is onstantly increasing.

Exercises in volley firing with the Gatling gun at sea have been con- inued, and are highly instructive as an exhibit of the low percentage f hits that may be expected when such guns are fired on board of ves- els in a sea-way by men not specially trained.

The results emphasize the necessity of specialists in the batteries of ships of war, and the experiments will be continued at greater length under the conditions of actual service.

The new Gatling guns lately ordered for the steel cruisers are to be furnished with the improved feed recently adopted by the company. This arrangement permits high-angle fire to be delivered, which will add greatly to the value of the piece, as it is certain that curved fire will be a prominent feature in future combats.

SMALL-ARMS.

There has been no marked development of service small-arms since the last report.

The left-hand movement gun has been improved, and is manufactured as a sporting gun, but is not yet offered in the market as a military rifle.

Seven hundred Lee magazine rifles were bought lately on advantageous terms for the armament of the new cruisers.

The Bureau now furnishes a superior woven-loop cartridge belt, carrying one hundred cartridges in two rows, with four pockets for Lee magazines. This belt is supported by convenient shoulder-straps, and is considered a great improvement over the old styles.

Sailors when landed for service are now furnished with regulation knapsacks and canteens, which are purchased from the Ordnance Department of the Army. This addition makes the outfit of the seamen, when on shore, much more complete and comfortable than it formerly was.

HIGH-POWER MUSKET.

This piece is by far the most notable development of small-arms that has taken place this year. It is the design of Lieut. Commander W. M. Folger, inspector-in-charge of the Naval Ordnance Proving Ground, who first called attention to its merits.

By enlarging the chamber of an ordinary Lee magazine rifle in very much the same way as the modern high-power great gun has been developed, Lieutenant-Commander Folger has produced a piece which, furnished with a steel bullet of his design, pierces at short range $\frac{3}{4}$ of an inch of soft steel placed normally, and $\frac{1}{2}$ of an inch placed at an inclination of 45 degrees.

The muzzle velocity varies with the charge and projectile from 1,800 to 2,026 feet per second; that usually obtained in the ordinary military rifle is about 1,350 feet per second.

This performance for a .45 caliber piece is certainly extremely satisfactory, and plainly indicates what we may expect from the musket in the future.

The piece now in use is discharged from a pivoted rest not unlike that which was formerly used with rail pieces, and it is probable that the high-power musket will ultimately be employed with such a mount on ship-board.

The reports on this matter will be found in the Appendix, page 453.

CLARK'S DEFLECTIVE TURRET.

An act of Congress having directed trials to be made of Clark's Deflective Turret, under the direction of the Naval Advisory Board, it became the duty of the Bureau (as a matter of routine) to procure the

r for the target and to have the structure erected and prepared for

cordingly, after some correspondence, the steel plates for the tar- re lered of the Messrs. Schneider & Co., Creusot, France, and woo n part of the structure of the Pusey & Jones Company of n, Del., which firm is also to join and erect the whole target. steel plates have arrived and are in possession of the latter com-

Bureau has not been able to advance a 10-inch gun far enough be probably ready to fire against this target as soon as completed, to use a gun of less caliber would be to unduly favor the target. thought that a 10-inch gun can be prepared in about six months.

SEAMEN GUNNERS.

T instruction of seamen gunners at the Ordnance Department of Washington navy-yard is continued, and a number of these young e received a training which will contribute very greatly to their re fulness in the service.

It is proposed to send a class to the Torpedo Station as soon as con- nt.

THE ARMAMENT OF THE NEW VESSELS.

e last report contracts have made for steel forgings for one h, eight 8-inch, and twelve 6-inch guns, also for the rings for the kets and tubes of the two 10-inch guns ordered by the Bureau in the vious year.

The forgings for the 6-inch caliber were ordered of the Midvale Steel orks, Nicetown, near Philadelphia. Those for the 8-inch guns were red in England, part from Charles Cammell & Co., of Sheffield, and from Sir Joseph Whitworth & Co., of Manchester, and they are to used in manufacturing the armament of the steel cruisers now in of construction.

dvale Steel Company has completed the eight sets of 6-inch ings ordered last year and has made good progress on the twelve since ordered, having cast and hammered all the large pieces and tempered some of them. This work is now being pressed by the ny.

steel thus far presented has, as a rule, been satisfactory in ty—the rings being particularly successful and quite equal to any have been obtained from abroad. The Midvale Company has lately t in an oil tempering plant, and now use oil treatment with all their h gun forgings.

very great delay has been experienced in obtaining some of the h forgings from England. Charles Cammell & Co. have delivered st of the jackets and tubes ordered from them. Sir Joseph Whit- rth & Co. have delayed very much in the delivery of their steel, and ne greater part of it has not yet come to hand, neither is it certain en it can be expected. Having no plant of our own capable of pro- ducing 8-inch forgings, we are, of course, at the mercy of the foreign manufacturers in the matter of time.

Three of the Cammell tubes and jackets have been put together, and he rings furnished by the same company are being oil-treated, pre- tory to being placed on the guns.

The ordnance machine-shops at the Washington Navy-Yard are at ast commencing to receive steel forgings in sufficient number to enable

the inspector to prosecute work to advantage, and the activity at the yard will increase considerably within the next few months.

One 6-inch gun of the general type to be used in the cruisers has been finished, and has had an extended trial and use at the Naval Ordnance Proving Ground, Annapolis, Md.

This gun is for the Dolphin, and has fired about 150 rounds with large charges of powder of different specifications and projectiles of 100 pounds weight. Its performance is very satisfactory. It has been ranged, and shows a very flat trajectory, with great smoothness of flight of the projectiles. (See Appendix).

The Bureau has made contracts for machine-finishing guns with two private firms, the South Boston Iron Works and the West Point Foundry Association. The former firm has received two sets of 6-inch forgings and has commenced work on them. The Bureau has not yet been able to furnish any to the West Point Foundry, but expects to do so ere long.

Owing to the delays and difficulties inseparable from the commencement of a work of such magnitude as the fabrication of steel high-power guns in the United States, the armament of the new cruisers cannot, under the most favorable circumstances, be completed until some months after the vessels are finished.

This fact was foreseen and many times represented when the construction of the cruisers was first proposed. Every exertion has been made to forward the work since then—designs were prepared in ample time and have not since been changed; but the difficulty of procuring material of the proper quality has been very great and has called for considerable patience.

The failure of Congress at its last session to appropriate promptly for the armament of the cruisers entailed an additional delay. Though the entire batteries of the vessels cannot be ready in time, the Bureau will be able to put part of the new guns on the ships when the latter are ready.

The secondary batteries and search-light outfits of the cruisers were ordered long since and are expected to arrive in time for the vessels.

Suitable circuits for electrical firing of the guns of the new cruisers have been laid out, and a plan of those intended for the Atlanta and Boston will be found in the Appendix, page 438.

A metallic powder tank (or cylinder) has been designed for the long heavy cartridges for the high-power guns of these vessels. Each tank contains one charge. It will be found figured in the Appendix. Each end of the cylinder is covered by a simple overlap top, cartridge paper being shellaced around the joint to make it water-tight. A cord lies in the joint under the paper, and the end (projecting) is used for tearing the paper when the covers are to be removed. This paper band is strong enough to sustain a much greater weight than the tank and its cartridge.

ARMAMENT OF THE PROJECTED SHIPS.

Agreeably to your directions, I have added to the other items an estimate of the amount of money required to arm certain vessels the construction of which was proposed to Congress during the last session. The amounts are computed from the best information available to the Bureau, and it is thought will be sufficient. The nature of the armament of these ships was determined by the Naval Advisory Board, except that of the armored cruiser of 8,500 tons, in which case, as the Board had not designated any battery, the "Riachuelo" type was adopted by the Bureau as a basis to estimate upon.

ARMAMENT OF THE DOUBLE-TURRETED MONITORS.

imates for the armament of the double-turreted monitors Puritan, iitrite, Monadnock, and Terror are also inserted. They are the as those submitted last year, and are urged for the same reasons re then given.

NEW NAVAL ORDNANCE PROVING GROUND.

space at our disposal at Annapolis, Md., for an ordnance proving is too restricted for the present and prospective development of ordnance. The neighborhood of farm houses, of the light-house, f the city of Annapolis make it somewhat dangerous to fire into t with projectiles from high-power guns, but the chief objection place is the fact that the range (which is over water) is often renuseless by the presence of fishing boats, oyster boats, and other upon it and in dangerous proximity to it; and is further embarby the neighborhood of the light-house near the battery and of hotel about half way down the range.

ts and other craft cause great delays in the work on the range, often obstruct it for days, and furthermore there is danger that not be seen on the more distant parts of the range, and perbe struck by a projectile, while the light-house and hotel are in r from pieces of shell or from projectiles accidentally leaving the ory by reason of imperfect rotation or from other causes.

ige over water is not as convenient as one over land, and all tiles fired upon it are lost. Furthermore, it is not possible to re the action of the percussion fuzes (nor, in fact, that of the time tisfactorily at Annapolis) on the more distant parts of the range, r can the rotation bands of projectiles be examined after flight. r these reasons the Bureau has inserted an estimate of $57,000 for purchase of a proving ground, and requests that the money may be e immediately available.

EXPERIMENTS WITH HIGH EXPLOSIVES.

uring the last session of Congress the idea was advanced that the t of a moderate weight of dynamite exploded in contact with the es of a modern armored ship would be disastrous to the vessel, iing in the side, &c.

number of experiments were undertaken by the Bureau for the se of ascertaining the effect of various charges of dynamite and otton-on armored targets.

harges of these explosives varying from 5 pounds to 100 pounds in it, were hung against a vertical target and exploded.

target was composed of 9 layers of 1-inch wrought-iron plates, ly backed with 20 inches of wood, and braced so as to represent ell as conveniently practicable the stiffness of the sides of a ship. he details of the experiments will be found recorded at length in a rt from Lieutenant Commander Folger (Appendix, page 467); the lt being that no material injury occurred to the vertical target, igh much more work was performed against it than would be likely to be performed against a single spot on the armored side of a ship. was also shown that even were a considerable charge exploded in t with the plates at the water-line, the effect would not probably erially increased.

ie effect of 26 pounds of gun cotton exploded on top of a horizontal (three 1-inch layers), representing roughly an armored deck, was good, the plate being considerably shattered.

In the course of these experiments it was apparently showı point at which a charge of high explosive is ignited (with reı the target) has an important effect on the amount of work do Lieutenant-Commander Folger readily increased or diminis materially the effect of his charges accordingly as he ignited the side away from the plate or on the near side, and this standing the fact that the distance between the points of ig the two cases was only about a foot (the charge being 75 or 100 This result brings out strongly the fact that the mass of the self, before explosion, cannot furnish any tamping effect; but th duce the greatest effect the ignition must be at some interior p toward the rear. It also appears that the effects do not incı portionally to the increase of the charge, the ignition surface r constant.

The gradual ignition of the charge, and the tamping effect (panding gases produced by igniting at the point most distant target, was strikingly illustrated by the fact that when 26 poun compressed disks of gun cotton were piled upon an iron plat ploded from the top (without any tamping or cover) accurate im of the lower disks in the pile were stamped upon the iron bene In this case there did not seem to be the least doubt concerning plete explosion of the charge. Lieutenant-Commander Folger sions as to the effect of the point or points of ignition of charge explosives are most important in their bearing upon the questi effect of such charges.

Experiments were continued at the Naval Ordnance Provin touching the firing of gun-cotton shells from ordinary rifled Twelve rounds of shells loaded with compressed gun-cotton w from the 12-pounder howitzer, and thirteen rounds were fired 80-pounder breech-loading rifle, all with service gunpowder c the gun. The shells flew over the range as usual, and no ac any kind occurred (see Appendix, page 467).

Three unfuzed shells, charged with gun-cotton, were fired 80-pounder at the same target as had been used in the conta mite experiments. The shells exploded with great violence on iı shown by the number of fragments recovered, but the dama target was very slight, explosion taking place before any pract etration had occurred.

A number of gun-cotton shells were exploded at rest, on the by means of such fuzes as are used in ordinary gunpowder sh

In view of recent successful experiments at the Naval (Proving Ground, with a fuze designed to effect the explosive coı of wet gun-cotton, the Bureau has under consideration a plan proposed by Lieutenant Commander Folger which is intended t an ærial torpedo charged with 100 pounds of wet gun-cotton ploded over or upon the deck of an enemy's vessel. There doe pear to be great difficulty in accomplishing the successful dev of such a piece, which would become an effective factor in o armament, especially for harbor defense or smooth-water work pendix, page 467).

TORPEDO SEARCH LIGHTS.

A complete set of Mangin's projectors, with Gramme (Brotherhood engines, and the necessary apurtenances and coı have been ordered for each of the new cruisers.

The projectors are now being prepared by Messrs. Sautter, L & Co., of Paris, France; the engines by Mr. Peter Brotherhood

don, England. The dynamos and motors for the ships are to be mounted on one bed-plate, the engines being connected direct. Besides these, two projectors have been procured for the general service.

TORPEDO TRIALS.

Congress having passed an act (during the session before last) directing a competitive trial of torpedoes adapted to naval warfare (the trial to take place before a board designated by the honorable Secretary of the Navy), this Bureau sent notices regarding the matter to the prominent torpedo manufacturers and inventors in this country and in Europe.

When the time for the trial approached the fact was further advertised by the Department in the principal newspapers of the United States, and inventors and manufacturers were thus publicly invited to present themselves before the Board.

Only three persons complied with the invitation. The American Torpedo Company presented their directive torpedo, usually known as the Lay-Haight; Mr. Asa Weeks presented a rocket torpedo, and Commander John A. Howell, U. S. N., presented an auto-mobile torpedo.

The trials of these weapons took place chiefly in Hampton Roads, Va.; the result being that the Board did not recommend any of them, finding them "not adapted to naval warfare," in the sense that they were not adapted for use in action between ships of war at sea.

Besides the torpedoes that were brought before the Board at Hampton Roads, it witnessed the performance of the Sims Electrical torpedo at Willets Point. This was not considered as adapted to naval warfare.

In its report the Board spoke highly of the performance and probable abilities of Commander Howell's torpedo, and the Bureau has since undertaken the manufacture of three of these weapons, being strongly impressed with the value of the principal features embodied in the design. The cost of this torpedo is quite moderate and its construction is comparatively simple.

The report of the Torpedo Board will be found in the Appendix, page —.

Lieut. B. A. Fiske, U. S. N., has proposed a gun-torpedo to be discharged over water, and on arrival at the hostile ship to drop under water and explode, with the advantages of water tamping and more effective position as regards the enemy's armor. It is described in the Appendix, page 484.

An ingenious plan for an electrically controlled torpedo (proposed by the same officer) is also shown in the Appendix, page 512.

SWIFT TORPEDO-BOAT.

The purchase, in Europe, of the swift torpedo-boat recommended in last year's report is again respectfully urged.

The fact that the Department proposes to ask for two of these boats to be built in our country does not militate against the policy of purchasing one from one of the most celebrated firms abroad. No experience has been had in this country in building such boats. The one obtained in Europe would doubtless furnish our builders with many good practical suggestions, and as a large number of these craft must be ultimately built, the expense of purchasing one *now* is not very onerous.

The purchase of twenty-five auto-mobile torpedoes and one set of launching apparatus, from Messrs. Whitehead, is mentioned in the estimates in connection with the swift boat.

This purchase has been urged for the last two years, and the Bureau must continue to urge it until a weapon of equal value is produced in the United States.

The Whitehead torpedo is very far from being perfect, but it only practical auto-mobile torpedo now in use on the ships of naval powers.

INTERNATIONAL ELECTRICAL EXHIBITION.

The Bureau participated in the late International Electrical E tion of the Franklin Institute at Philadelphia, Pa.—Lieut. B. A. being in charge. His report will be found in the Appendix, pag It presents many interesting facts and useful proposals and sugges A number of the projects he advocates had already been under by the Bureau, as they were evidently in the direction of progres

TORPEDO STATION.

The torpedo station has remained in charge of Capt. T. O. Selfi U. S. N., and has been employed in the development of gun-cotto topedoes and of torpedo material generally.

The gun-cotton manufactory has been entirely finished, and is at providing a store of this excellent explosive for the use of the It is impossible to overrate the value and importance of this the manufactory in our country of the principal high explosive for mi uses, and the one which, by common consent abroad, has been ad for torpedoes on account of its safety.

It is thought that the product of this factory is fully up t European standard, and the amount turned out will be enoug present needs.

Considerable progress has been made in the manufacture of the cotton spar torpedo, and of the fittings connected with it.

A number of valuable experiments have been made on the com tive power and usefulness of various search-lights, and of the dyn and engines therefor.

A complete description of the different apparatus, with a repo the trials, will be found in the Appendix, page 494.

These experiments will be continued to determine, if possibl real value of search-lights and of the different types of apparatu

Instruction has been given to the usual class of officers, and attention and proficiency was considered very satisfactory.

The report of the Board which witnessed the examination wi found in the Appendix. It recommends certain changes in the me of instruction, &c., which had long before engaged the attention Bureau and of the station. Their views are considered in the mai rect, and efforts have been for some time in progress to acco what they recommend.

As mentioned in last year's report, a change in the course of ins tion was inaugurated this year whereby an opportunity was affor limited number of the students to pursue a longer and more s course after conclusion of the regular (or general) course. This tice will be continued and it is thought that it will be highly bene

The course of instruction for gunners was resumed this year, a officers who attended were reported by Captain Selfridge to hav quitted themselves well.

Extracts from Captain Selfridge's report will be found in the A dix, page 484.

I am, sir, your obedient servant,

MONTGOMERY SICARD
Chief of Bur

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy.

Estimates of appropriations required for the service of the fiscal year ending June 30, 1886, by the Bureau of Ordnance, Navy Department.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detailed object of expenditure.	Amount appropriated for the current fiscal year ending June 30, 1885.
SALARIES.		
Chief clerk (increase of $450 submitted, Rev. Stat., p. 70, sec. 416; act July 7, 1884, 24 Stat., p. 184)	$2,250 00	
NOTE.—The chief clerk is required by law to act as Chief of Bureau in case of vacancy or of the absence or sickness of that officer (in case other appointment is made). His duties are as responsible and arduous as those of the chief clerks in the other Executive Departments who are required by law to perform the same functions, and who now receive a like compensation, viz: $2,250 per annum.		
Draughtsman (same acts)	1,800 00	
Clerk of class three (Rev. Stat., p. 27, sec. 167; act July 7, 1884, 24 Stat., p. 184)	1,600 00	
Clerk of class two (same acts)	1,400 00	
Clerk, at $1,000 (act July 7, 1884, 24 Stat., p. 184)	1,000 00	
Assistant messenger (Rev. Stat., p. 27, sec. 167; act of July 7, 1884, 24 Stat., p. 184)	720 00	
Laborer (same acts)	660 00	
Clerk of class one (submitted)	1,200 00	
	10,630 00	8,980 00
NOTE.—The work of the Bureau has increased greatly of late years, owing to the increasing elaboration of ordnance material, and the smallness of the clerical force has caused the recording of the press copy-books to behind over three years.		
CONTINGENT.		
Stationery, books, and miscellaneous items (appropriated)	500 00	
ORDNANCE.		
For preserving and handling ordnance material of the kinds now in service; for the armament of ships therewith; for fuel, tools, material, and labor, to be used in the general work of the Ordnance Department; for furniture at magazines, at the ordnance dock, New York, and at the naval ordnance battery and proving ground (appropriated; 24 Stat., p. 262)	153,189 00	
For main and secondary batteries complete of the new types for four of the best third-rate ships now in service (submitted)	401,056 00	
Towards the general armament of the Navy with modern secondary batteries and small arms—		
30 machine cannon of moderate caliber (submitted)	89,220 00	
20 musket-caliber machine guns (submitted)	33,000 00	
3,000 magazine rifles (submitted)	101,250 00	
For proof of naval guns and appendages (submitted)	12,000 00	
For modern armament of two practice vessels for the training squadron (submitted)	10,000 00	
For purchase of land for proving and ranging ground for naval guns, and for constructing buildings, butts, shelters, batteries, &c. (submitted)	57,000 00	
	856,715 00	75,000 00
REPAIRS, ORDNANCE.		
For necessary repairs to ordnance buildings, magazines, gun parks, boats, lighters, wharves, machinery, and other objects of the like character (appropriated, 24 Rev. Stat., p. 262)	16,000 00	7,500 00
CONTINGENT.		
For miscellaneous items, viz: For freight to foreign and home stations; advertising, and auctioneers' fees; cartage and express charges; repairs to fire-engines; gas and water pipes; gas and water tax at magazines; [illegible] ferriage, foreign postage, and telegrams to and from the Bureau (appropriated, 24 Stat., p. 262)	5,000 00	1,500 00
[illegible] sum heretofore appropriated for the above items has been [illegible]ient. The Bureau was obliged to ask for a deficiency of $400 [illegible] fiscal year (1883–'84), which was appropriated; but unforeseen unavoidable contingencies on foreign stations have arisen which create still further deficiency.		

Estimates of appropriations required for the service of the fiscal year, &c.—Continued.

Detailed objects of expenditure, and explanations.	Estimated amount which will be required for each detail-d object of expenditure.	Amount appropriated for the first six months of current fiscal year ending June 30, 1886.
CIVIL ESTABLISHMENT.		
For the civil establishment at navy-yards (appropriated, 24 Stat., p. 262)	$11, 217 25	$2, 500
NOTE.—The increase asked for in the above item is to restore the former civil establishment under this Bureau, except at the Washington navy-yard, where it increases the pay of the principal clerk to $1,600, and provides for one clerk at $1,200, and a writer at $1,000; it also changes the pay of the clerk at the Portsmouth and Mare Island yards to $1,150 each. No clerk or writer is asked for at Pensacola or League Island.		
TORPEDO CORPS.		
For labor, material, freight and express charges, general repairs to grounds, buildings, wharves, &c., boats, instruction, instruments, tools, furniture, experiments and general torpedo outfits (appropriated, 24 Stat., p. 262)	60, 000 00	
NOTE.—Gun-cotton is now being used as the charge of torpedoes in lieu of gunpowder, which has heretofore been paid for from appropriation "Ordnance."		
For the purchase of a torpedo-boat, and the working drawings of the same (submitted)	55, 000 00	
	115, 000 00	25,
NOTE.—The purchase of a fast torpedo-boat from one of the leading builders of the world will furnish our people with a type and example of the most advanced form of construction, which is not now available.		
MONITORS—ORDNANCE.		
Amount required to supply the ordnance outfits of the monitors Puritan, Terror, Miantonomoh, Amphitrite, and Monadnock (submitted)	1, 073, 000 00	
NOTE.—No torpedo outfit is estimated for. If an auto-mobile, similar to the Whitehead, should be used, $100,000 additional would be necessary.		
STEEL RIFLED BREECH-LOADING GUNS.		
To continue the development of type guns for the Navy:		
One 12-inch breech-loading rifle (submitted)	60, 000 00	
One 17-inch breech loading rifle (submitted)	170, 000 00	
One 12-inch breech-loading rifle (wire-wound) (submitted)	60, 000 00	
Ammunition for test, &c	20, 000 00	
	310, 000 00	41, 63
INCREASE OF THE NAVY.		
For main and secondary batteries complete for the New York	300, 900 00	
For the armament of the additional vessels proposed by the Navy Department, viz:		
One cruiser of 4,500 tons (submitted)	275, 902 00	
One cruiser of 3,000 tons (submitted)	181, 996 00	
One dispatch vessel of 1,500 tons (submitted)	101, 214 00	
One heavily armed gunboat, 1,500 tons, No. 1 (submitted)	112, 910 00	
One heavily armed gunboat, 1,500 tons, No. 2 (submitted)	126, 226 00	
One light gunboat, 750 tons (submitted)	65, 644 00	
One gunboat, 900 tons (submitted)	113, 875 00	
One steel ram (submitted)	28, 106 00	
One cruising torpedo-boat (boat and armament complete) (submitted)	97, 500 00	
Two harbor torpedo-boats (boat and armament complete) (submitted)	117, 000 00	
One armored vessel, 8,500 tons (submitted)	480, 615 00	
	2, 001, 918 00	
NOTE.—In making these estimates the price of English steel has been used in calculating the cost of all 8′ and 10′ guns. If American steel could be used, the price of the steel for *these calibers* would be increased 50 per cent. making an increase in the estimates of about $120,000. The estimates for the torpedo-boats are made by taking the English prices for the largest and swiftest types (133 feet and 110 feet long respectively), and adding 30 per cent. to the cost. The entire cost of these torpedo-boats is estimated for above. If this Bureau is to furnish their armament only, it will cost $65,678, assuming that a torpedo costing the same as the Whitehead is to be used.		

Respectfully submitted.

MONTGOMERY SICARD,
Chief of Bure

BUREAU OF ORDNANCE,
Navy Department, October 20, 1884.

[illegible]UFACTURES AND PREPARATIONS AT THE NAVY-YARDS AND STATIONS FOR THE YEAR ENDING JUNE 30, 1884.

ARTICLES UNDER PROPORTION TO EACH GUN.

8-inch M. L. R. impression instruments, bore.
inch M. L. R. passing boxes.
inch M. L. R. shrapnel-steel.
inch M. L. R. shrapnel, cast iron.
inch M. L. R. sight-bars, central.
inch M. L. R. sight-bars, side.
inch M. L. R. canister.
inch M. L. R. cartridge-bag pattern.
inch M. L. R. canister.
[illegible] inch M. L. R. clevis-bolts.
4 [illegible] nch M. L. R. pivot-sockets.
8-inch M. L. R. pivot-socket covers.
8-inch M. L. R. shell-bearers.
8-inch M. L. R. shell-loaders.
[illegible] set 8-inch M. L. R. deck circles.
2 8-inch M. L. R. extractors, shell.
2 8 inch M. L. R. cap-square wrenches.
3 8-inch M. L. R. rammer-heads, bronze.
12 8-inch M. L. R. sponges, bristle.
6 8-inch M. L. R. thumb-screws.
1 set 8-inch M. L. R. breeching preventers.
12 8-inch M. L. R. breechings.
8 8-inch M. L. R. gun-tackles.
12 8-inch M. L. R. pivot-tackles.
4 8-inch M. L. R. shifting-tackles.
4 8-inch M. L. R. train tackles.
8 8 inch M. L. R. shifting and train tackles,
10 8-inch M. L. R. in and out tackles.
43 8-inch M. L. R. sheepskin sponge-covers.
4 8-inch M. L. R. sheepskin sponges.
21 8-inch M. L. R. sponge-caps, canvas.
8 8-inch M. L. R. rammers.
3 sets 8-inch M. L. R. gun-gripes.
19 8-inch M. L. R. muzzle-bags.
6 8-inch M. L. R. cartridge-bag formers.
4 8-inch M. L. R. rail-chocks.
2 8 inch M. L. R. gun slings.
4 sets 8-inch M. L. R. reloading tools.
1 XV inch M. L. S. B. sheepskin sponge-cover.
1 XV-inch M. L. S. B. muzzle-bag.
6 IX-inch M. L. S. B. blanks, lock.
40 IX-inch M. L. S. B. breechings.
11 IX-inch M. L. S. B. tackles, out.
8 IX-inch M. L. S. B. train-tackles.
6 IX-inch M. L. S. B. tackles, side.
5 IX-inch M. L. S. B. tackles, pivot.
43 IX-inch M. L. S. B. tackles, in and out.
12 IX-inch M. L. S. B. tackles, shifting and train.
87-IX-inch M. L. S. B. sheepskin sponge-covers.
35 IX-inch M. L. S. B. canvas sponge-covers.
1 set IX-inch M. L. S. B. gun-gripes.
39 IX-inch M. L. S. B. muzzle-bags.
20 IX-inch M. L. S. B. canister.
2 IX-inch M. L. S. B. dismounting straps.
2 IX-inch M. L. S. B. dismounting chocks.
4 VIII-inch M. L. S. B. sheepskin sponge-covers.
24 32 pounder M. L. S. B. sheepskin sponge-covers.
1 pair XIII inch M. L. S. B. shell-tongs.
2 6-inch B. L. R. S carriages, hydro-pneumatic.
1 6-inch B. L. R. S. pivot-socket.
1 6-inch B. L. R. S. hooped.
1 6-inch B. L. R. S. shell.
2 6-inch B. L. R. S. shell-boxes.
2 6-inch B. L. R. S. De Bange gas-checks.
2 sets 6-inch B. L. R. S. pivot circles.

1 set 6-inch B. L. R. S. pivot-clamps.
1 6-inch B. L. R. S. loading scoop.
1 6-inch B. L. R. S. cartridge-bag pattern.
16 6-inch B. L. R. S. sponge-caps, canvas.
13 6-inch B. L. R. S sponge-covers, sheepskin.
4 6-inch B. L. R. S. sponges, bristle.
4 6-inch B. R. L. S. sponges, sheepskin.
6 6-inch B. L. R. S. trunnion bearings.
4 6-inch B. L. R. S. gauges, shell.
4 6-inch B. L. R. S. wrenches, nose-plate.
1 6-inch B. L. R. S. wrenches, combination.
1 6-inch B. L. R. S. cam-lever and face-plate.
1 set 6-inch B. L. R. S. port-sill pivot-clamps.
1 6-inch B. L. R. S. extension piece, bronze.
1 6-inch B. L. R. S. primer reloading tool.
1 6-inch B. L. R. S. mushroom and stem.
2 6-inch B. L. R. S. nose-plate springs.
4 6-inch B. L. R. S. De Bange check-pads.
2 6 inch B. L. R. S. De Bange check-cups, steel.
2 6-inch B. L. R. S. De Bange check-cups, bronze.
2 80-pounder B. L. R. P. impression instruments, bore.
1 80-pounder B. L. R. P. mushroom and stem.
1 80-pounder B. L. R. P. breeching.
6 60-pounder B. L. R. P. sponge-heads, bristle.
22 60-pounder B. L. R. P sponges, bristle.
10 60-pounder B. L. R. P. sponge-caps, canvas.
14 60-pounder B. L. R. P. sponges, sheepskin.
16 60-pounder B. L. R. P. sponge-covers, sheepskin.
16 60-pounder B. L. R. P. pivot-sockets.
6 60-pounder B. L. R. P. pivot-socket covers.
7 60-pounder B. L. R. P. pivot-bolts.
8 60-pounder B. L. R. P. clevis-bolts.
5 60-pounder B. L. R. P. impression instruments, bore.
5 60 pounder B. L. R. P. small-arm firing attachments.
4 60-pounder B. L. R. P. firing attachment leaves.
9 60-pounder B. L. R. P. tompion-blocks.
1 60-pounder B. L. R. P. loading scoop.
8 60-pounder B. L. R. P. firing attachments, primer.
1 60-pounder B. L. R. P. chamber-scraper.
1 60-pounder B. L. R. P. nose-plate stem.
1 60-pounder B. L. R. P. rack.
6 60-pounder B. L. R. P. sponge heads and staves.
1 60-pounder B. L. R. P. breeching toggle.
4 sets 60-pounder B. L. R. P. gun-gripes.
2 60-pounder B. L. R. P. cartridge-bag formers.
1 60-pounder B. L. R. P. breech-cover
2 60-pounder B. L. R. P. hook-ropes.
1 60-pounder B. L. R. P. box for reloading tools, primer.
8 30-pounder B. L. R P. sponges, bristle.
8 30-pounder B. L. R. P. sponges, sheepskin.
8 30-pounder B. L R. P. sponge-covers.
16 30-pounder B. L. R. P. sponge-caps, canvas.
623 20-pounder B. L. R. P. followers.
1 set 20-pounder B. L. R. P. breech mechanism.
4 20-pounder B. L. R. B. dummy-shot.
3 20-pounder B. L. R. B. bristle-sponges.
6 20-pounder B. L. R. B. sheepskin sponges.
4 20-pounder B. L. R. B. sheepskin sponge-covers.
3 20-pounder B. L. R. B. canvas sponge-covers.
4 20-pounder B. L. R. B. carriages.
4 20-pounder B. L. R. B. pivot-sockets, nuts and washers.
1 20-pounder B. L. R. B. collar-latch.
1 20-pounder B. L. R. B. thumb-latch.
1 20-pounder B. L. R. B. combination wrench.
2 20-pounder B. L. R. B. nose-plate wrench.
2 20-pounder B. L. R. B. muzzle-bags.
30 20-pounder B. L. R. B. canister.
5 20-pounder B. L. R. B. canister-boxes.
24 20-pounder B. L. R. B. quoins, chocking.
20 20-pounder B. L. R. B. wash-deck chocks.

3 20-pounder B. L. R. B. pivot-bolts.
3 20-pounder B. L. R. B. elevating-screws.
4 20-pounder B. L. R. B. sights.
4 20-pounder B. L. R. B. train-rope hooks.
3 20-pounder B. L. R. B. metal blocks.
2 20-pounder B. L. R. B. breech-covers.
4 20-pounder B. L. R. B. tackles.
4 20-pounder B. L. R. B. breechings.
4 20-pounder B. L. R. B. train-ropes.
6 20-pounder B. L. R. B. hook-ropes.
222 deck-circle screws.
4 armorer's tool-chests.
4 pivot-sockets, nuts, and washers.
8 patterns, sheepskin sponge-cover.
30 handspikes, roller, No. 2.
16 handspikes, ordinary.
1 extractor, shell.
271 vent-guards.
51 toggles for lock-laniards.
171 laniards, lock.
65 laniards, friction primer.
153 runners, friction primer laniard.
1 set powder-sieves.
2 arm-chests, boat.
2 arm-chests, small.
12 sets fittings for armorer's tool-chest.
1 set dies and gauge for powder pellets.
70 metal-blocks, large.
1 shaft for Ericsson carriage.
18 fire-buckets.
24 fire-bucket hooks.
7 bags, division.
6 boxes, division.
57 swabs.
8 pairs breeching-starts.
78 selvagees for breechings.
17 powder and shell whips.
376 port laniards.
68 port bridle-laniards.
113 fire-bucket laniards.
6 targets for great guns.
17 target-frames.
8 supply and reserve boxes.
19 fire and division tubs.

HOWITZERS, MACHINE GUNS, EQUIPMENTS, ETC.

2 3-inch B. L. H. of 500 pounds.
8 3-inch B. L. H. boat carriages.
898 3-inch B. L. H. shell.
767 3-inch B. L. H. shrapnel.
1,094 3 inch B. L. H. shell-followers.
1,133 3-inch B. L. H. shell-plugs.
100 3-inch B. L. H. shell-boxes.
6 3-inch B. L. H. sponge-buckets.
17 3-inch B. L. H. dummy cartridges.
14 3-inch B. L. H. bristle sponges.
14 3-inch B. L. H. caisson-boxes.
2 3-inch B. L. H. impression instruments.
20 3-inch B. L. H. rear sights.
5 3-inch B. L. H. shell-plug wrenches.
8 3-inch B. L. H. sponge-caps, canvas.
23 3-inch B. L. H. elevating screw pins.
420 3-inch B. L. H. sabots.
4 3-inch B. L. H. dismounting-bars.
4 3 inch B. L. H. gun-boxes.
1 3-inch B. L. H. dismounting-strap.
1 3-inch B. L. H. wiper-box.
1 3-inch B. L. H. loading-pouch.
3 3-inch B. L. H. gun-covers.

1 3-inch B. L. H. spare article box.
2 3-inch B. L. H. sponges, sheepskin.
6 3-inch B. L. H. pivot-bolts.
5 12-pounder H. sheepskin sponge-covers.
50 12-pounder L. rings, cartridge-bag.
6 12-pounder L. sponge-caps, canvas.
2 12-pounder L. sponge-covers, woolen.
1 12-pounder L. sponge-cover, woolen.
6 Gatling-gun tripods, long.
14 Gatling-gun tripods, short.
1 Gatling-gun wiper-rod.
3 Gatling-gun, long, turtle-back mounts.
6 Gatling-gun firing-pins.
2 Gatling-gun haversacks.
6 Gatling-gun oil-cans.
2 Gatling-gun elevating clamp screws.
5 Gatling-gun covers.
1 Gatling-gun field-carriage linchpin.
1 Gatling-gun drag-rope.
1 Gatling-gun field-carriage washer.
1 Gatling-gun box for iron work.
1 Gatling-gun elevating-screw guide.
4 Hotchkiss revolving-cannon cone mounts.
1 Hotchkiss revolving cannon rail-socket.
250 rounds Hotchkiss revolving-cannon ammunition.
2 Hotchkiss revolving-cannon caisson-boxes.
4 Hotchkiss revolving-cannon pivots.
21 Hotchkiss revolving-cannon shell-boxes.
8 haversacks, leather.
50 toggles, drag-rope.
4 shoes for boat-carriages.
6 shoes for howitzer wheels.
6 sets deck-chocks for field and boat carriages.
8 sets deck-chocks for howitzer field carriage.
2 sets boat-tracks.

SMALL ARMS.

462 single sticks.
1 chest small-arm equipments.
6 target-plates, small arm.
24 grommets for arm-chest.

MAGAZINE STORES.

50 8-inch M. L. R. cartridge-bags, 45 pounds, white.
40 8-inch M. L. R. cartridge bags, 40 pounds, white.
234 8-inch M. L. R. cartridge-bags, 35 pounds, white.
1,310 8-inch M. L. R. cartridge-box, 25 pounds, white.
1,591 8-inch burster bags.
2 8-inch B. L. R. S. cartridge-bags, standard.
421 VIII-inch M. L. S. B. cartridge-bags, 7 pounds.
25 80-pounder B. L. R. cartridge-bags, 20 pounds, white.
43 80-pounder B. L. R. cartridge-bags, 15 pounds, white.
50 80-pounder B. L. R. cartridge-bags, 8 pounds, white.
54 80-pounder B. L. R. burster bags.
4 sets 80-pounder B. L. R. cartridge-bag formers.
50 60-pounder B. L. R. cartridge-bags, 10 pounds, white.
1,753 60-pounder B. L. R. cartridge-bags.
385 60-pounder B. L. R. burster-bags.
1 60-pounder B. L. R. burster-bag pattern.
12 sets 60-pounder B. L. R. cartridge-bag formers.
2 sets 30-pounder B. L. R. cartridge-bag formers.
436 20 pounder B. L. R. P. cartridge-bags.
6,305 20-pounder B. L. R. B. cartridge-bags, 2 pounds.
2 sets 20-pounder B. L. R. cartridge-bag formers.
50 20-pounder B. L. R. saluting charges.
119 6-inch B. L. R. S. cartridge-bags, 35 pounds.
1 XI-inch M. L. S. B. cartridge-bag pattern.
100 XI inch M. L. S. B. cartridge bags, 30 pounds, white.
225 32-pounder M. L. S. B. cartridge-bags, 6 pounds, white.
527 32-pounder M. L. S. B. cartridge-bags, 4 pounds, red.
593 32-pounder M. L. S. B. cartridge-bags, mixed.

500 24-pounder howitzer cartridge-bags.
,788 3-inch B. L. howitzer cartridge-bags, 12 ounces.
300 3-inch B. L. howitzer cartridge-bags, 16 ounces.
300 12-pounder howitzer cartridge-bags, 16 ounces.
200 3 pounds saluting charges.
10 7 pounds saluting charges.
710 brass rings for 12 and 24 pounder cartridge-bags.
,609 N. M. S. fuzes, spherical.
,078 N. M. S. fuzes, rifle.
,698 Boxer fuzes.
797 Bormann fuzes.
1,010 fuze-magazines.
500 igniters, fuze.
755 adapters, fuze.
1,224 primers, steel vent-closing.
6,082 primers, quill-friction.
21 primers, vent-sealing, electric.
43 pairs magazine-shoes.
34 magazine-dresses.
5 magazine-screens.
4 canvas covers for magazine-screens.
4 chutes, powder.
15$\frac{1}{16}$ pounds quick-match.
12 magazine-swabs.
26 boxes for powder-cases.
12 boxes for gun-cotton cases.
6 boxes for gun-cotton.

MISCELLANEOUS.

1 6-inch carriage transom.
1,388 pressure disks, copper, $\frac{1}{2}$-inch.
4 6-inch steel shot, experimental.
4 pressure-gauge housings.
2 supports for ammunition-boxes.
991 pounds shrapnel balls.
2 molds for gas-check grommets.
1 model of water rotary engine.
1 specimen, standard, steel.
18 pressure-gauge cutters, spiral.
1 bed-plate, field-carriage, short Gatling.
1 fore-stay bolt, VIII-inch carriage.
1,000 balls, rifle, calibre .45.
1 set patterns, 6-inch carriage.
2,356 pounds bars, lead, for rifle-balls.
3,216 pounds bars, lead, for shrapnel-balls.
2 cases, book.
2 stands, book.
18 boxes, cup gas-check.
24 hasps and staples, arm-chest, small.
24 hasps and staples, arm-chest, large.
1 set grate-bars for steam-launch.
4 springs for 80-pounder, locking-lever.
265 hooks, magazine screen.
280 handspike rollers.
1 foot for 20-pounder D. B. carriage.
6 tallies for keys.
54 blocks, primer, wood.
162 boxes, packing.
3 drawing-boards.
72 hinges, arm-chest, large.
90 rings for handles, fire and sponge buckets.
4 trucks, carriage, IX-inch.
2 bolts, iron.
24 buttons for division-boxes.
65 hooks, powder-chute.
16 unions for tubing, and wrench.
2 levers for spring-valves, 8-inch carriage.
1 set dies for sponge and fire-bucket.
2 work-benches.

29 pieces oak backing for target.
1 stand-top.
12 boxes for steel vent-closing primer reloading tools.
4 chests, boat.
6 brackets, axe, and screws, IX-inch.
1 wheel-chain, $\frac{3}{4}$-inch links.
1 wheel-chain, $1\frac{3}{8}$-inch links.
1 steady-head for large lathe.
2 dies for testing wire.
150 eye-bolts for securing arm-chests.
1 set side-pipes, 8-inch carriage.
4 indicators, 8-inch carriage.
1 piston-head, 8-inch carriage.
2 cylinders, complete, 8-inch carriage.
2 worms, 8-inch carriage.
2 wheels, worm, 8-inch carriage.
1 air-pump and attachment for 6-inch carriage.
40 specimens, standard.
200 hooks, friction-primer laniard.
27 fire-buckets.
1 stand.
8 tool-chests.
1 megaphone.
1 pressure-gauge, A. D., $\frac{1}{4}$-inch.
1 pressure-gauge, A. E., $\frac{1}{4}$-inch.
1 crusher-gauge, B., $\frac{1}{6}$-inch.
1 crusher-gauge, C., $\frac{1}{6}$-inch.
1 set rings, points, and groove-guides.
1 IX-inch carriage-truck.
14 bolts, iron.
1 dingy, pulling.
1 template for shield, 6-inch carriage.
30 zinc castings.
1 set patterns, 6-inch cartridge-bag.
2 clamps for testing-machine.
2 sets port-shutter fastenings.
1 set bracket patterns, 6-inch carriage.
2 shelves.
4 frames.
24 rollers for drawing.
1 model of Lundborg ship.
4 tarpaulins.
7 pairs brackets, rammer, and sponge.
10 fuzes, experimental.
1 smoke-stack.
200 gas-checks for pressure-gauges.
1 boring-bar, 8-inch B. L. R.
2 tables.
1 tee-square.
1 box for pressure-gauge.
1 target.
8 shell-bands, 60-pounder, experimental.
1 set patterns for steel rings, 3-inch.
106 hooks, port-laniard.
2,880 $\frac{1}{4}$-pound castings, Greely relief expedition.
2 grates for steam-launch.
1 gun-truck.
2 models, 6-inch cartridge-case.
38 rammer and sponge hooks.
1 skeleton, 8-inch B. L. R. gun.
1 skeleton, 6-inch B. L. R. gun.
2 skeletons, 6-inch B. L. R. carriage.
1 skeleton, 8-inch B. L. R. carriage.
1 skeleton, 5-inch B. L. R. carriage.
1 skeleton, Hotchkiss 47 $^{m}/_{m}$ gun and carriage.
2 sample bags, Greely relief.
11 ice-borers.
9 hooks, fire-bucket.
18 hooks, battle-lantern.
388 brackets, cutlass, large.

280 brackets, cutlass, small.
1 section of side of ship Boston.
1 pattern, 8-inch pivot, Chicago.
580 bronze castings.
1 ear trumpet.
1 sound collector.
1 set patterns for Hotchkiss tower mount.
3 models of gun and mount, Gatling.
38 key tallies.
1 hand-rail.
104 tank tallies.
8 boxes.
1 starting-bar.
3 clamp-screws.
1 can.
1 port-fire box.
6 stationery boxes.
4 shell stands.
1 pattern, pivot-bolt.
8 port-sweeps.
4 topping lifts and guys.
2 after-guys.
12 candlestick springs.
1 cabinet.
1 Whitehall boat.
1 boat, sail.
8 handles for battle-axes.
1 cap-square bolt.
4 frames.
2 inner doors, magazine.
32 pins for target frames.
130 bungs for powder barrels.
7 oars for boat.
Repairs to stores on hand.
Repairs to stores for vessels fitting.
Repairs to stores for vessels in commission.
Repairs to buildings, wharves, shot-beds, gun-skids, &c.
Guarding public property.

TORPEDOES.

42 pounds dynamite.
18 pounds explosive gelatine.
457 electric cannon primers.
1,366 D. E. fuzes.
1,768 D. E. igniters.
52 tripod gun-cotton torpedoes.
312 brass cylinders.
44 primer cases.
60 torpedo cases.
52 secondary spars.
44 outfit boxes, gun-cotton.
44 magazine boxes.
2 test bell.
6 copper boxes.
1,215 detonators.
62 dummy detonators.
2 sets spar bands.
6 wrenches, gun-cotton.
3 sets torpedo outfits for the Greely Relief Expedition.
2 immersion batteries.
4 gun-cotton spars.
22 connectors.
1 chronograph.
17 experimental gun-cotton torpedoes.
21 experimental exercise gun-cotton torpedoes.
2 gun-cotton driers.
1,352 pounds liquid carbonic acid.
48 galvanometers.
1 set launch fittings for gun-cotton torpedoes.
100 water caps.

17 experimental gun-cotton detonators.
12 detonator boxes.
18 contact primer cases.
4 boat spars.
Rewinding chronograph magnet.
Contact fire-torpedo case.
Hand grenade.
Repairs to deteriorated stores on hand.
Repairs to deteriorated stores from ships.
Repairs to tools, &c.
Repairs to boats, engines, boilers, &c.
Repairs to buildings, wharves, &c.
Guarding public property.
Experimental work of all kinds: Explosives, fuses, electric lights and apparatus; electric batteries, torpedoes, shunt, electricity, galvanometers, disintegrated gun-cotton, dynamo machines.

LIST OF VESSELS FOR WHICH WORK HAS BEEN PERFORMED DURING THE FISCAL YEAR ENDING JUNE 30, 1884.

Alarm.	Independence.	Montauk.	Shenandoah.
Alert.	Jamestown.	Nantucket.	Swatara.
Atlanta.	Jason.	New Hampshire.	Tallapoosa.
Boston.	Kearsarge.	Omaha.	Tennessee.
Chicago.	Lackawanna.	Ossipee.	Trenton.
Colorado.	Lancaster.	Ounalaska.	Vandalia.
Constellation.	Marion.	Pensacola.	Wabash.
Dale.	Miantonomoh.	Portsmouth.	Wachusett.
Despatch.	Michigan.	Powhatan.	Wyandotte.
Dolphin.	Minnesota.	Quinnebaug.	Wyoming.
Franklin.	Mohican.	Richmond.	Yantic.
Galena.	Monocacy.	Saratoga.	
Hartford.	Monongahela.	Saugus.	

Alert, Bear, and Thetis—relief of Lady Franklin Bay Expedition to the Arctic regions.
Patterson—Coast Survey steamer.

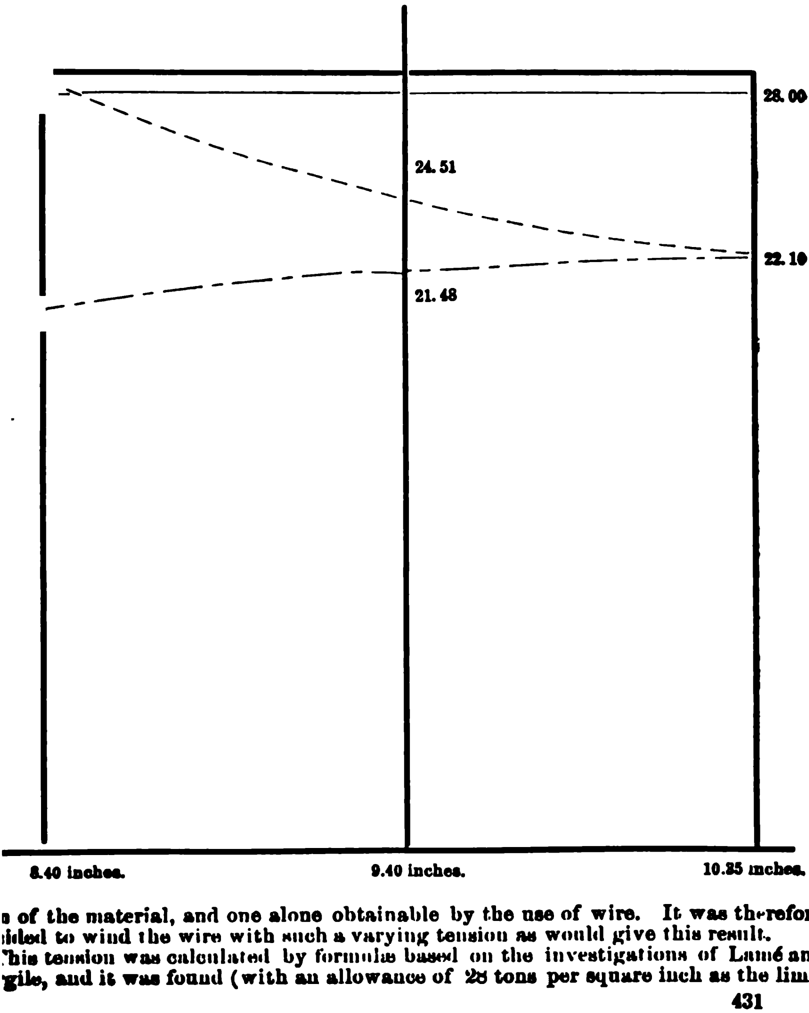
APPENDIX.

OTE ON THE CONSTRUCTION OF THE SIX-INCH WIRE-WOUND GUN.

By Ensign PHILIP R. ALGER, U. S. N.

he jacket and tube of this piece are of nearly the same dimensions as those of the 6" al hooped guns; but hoops on the cylinder and chase have been replaced by wire, result being a decrease of weight of about 1,000 pounds as compared with the ped guns, while the strength remains the same.

t was desired that each layer of the wire should be strained to the same amount r the pressure of explosion of the charge, this being the most favorable disposi-



n of the material, and one alone obtainable by the use of wire. It was therefore ided to wind the wire with such a varying tension as would give this result.

This tension was calculated by formulæ based on the investigations of Lamé and gile, and it was found (with an allowance of 28 tons per square inch as the limit

of strain on the wire) that the inner layer should be wound with that tension, and that the tension should decrease almost uniformly to 22 tons on the square inch at the outer layer.

There being thirteen layers of wire over the body of the gun, it was necessary to decrease the tension by about 25 pounds at each layer.

The wire over the chase of the gun being subject to much less strain than that over the chamber, it was considered unnecessary to wind it with varying tension.

That over the forward part of the jacket was wound with a constant tension of 20 tons to the square inch, and that over the tube with a constant tension of 15 tons to the square inch.

This is the first gun known to have been wound with a varying tension calculated with the object of bringing the walls of the powder-chamber and all the layers of wire to the elastic limit together under the strain of firing.

The wire is made of English stock, drawn in this country, and is not of as uniform and high a grade as was desired, its tensile strength being from 55 to 65 tons, and its elastic limit from 28 to 38 tons per square inch.

The gun was carefully star-gauged before and after winding, and showed a uniform compression of bore, agreeing very well with the results of calculation.

The following diagram shows the state of the wire over the chamber of the gun as calculated (after winding) with the gun at rest, and also under a chamber pressure of 19.5 tons per square inch.

The dotted line shows the tension of winding, the dash line the tension after winding, and the full line the tension under 19.5 tons internal pressure.

ON THE TENSION OF WINDING WIRE GUNS.

By ENSIGN PHILIP R. ALGER, U. S. N.

If wire be wound upon a tube, the inner layers will evidently be more and more relieved of tensile strain as the winding proceeds, in consequence of the compressive force exercised by the outer layers, and, on the completion of the winding, the inner layer will be at a considerably less, and the outer layer at the same tension as that of winding. Consequently, when an internal pressure is applied, the exterior layers of wire will first be brought to a higher tension than that at which they were wound, and, if the tension of winding be high, will also first be strained beyond the elastic limit and permanently stretched.

In order, then, that the application of an internal pressure may strain the layers of wire uniformly, it is necessary that the layers be wound with a varying tension, and the object of this investigation is the determination of the proper tension of winding each layer.

We will consider the case of a simple tube wound with wire. We wish to determine the thickness of the tube, the number of layers of wire, and the tension of winding each layer, so that under a given internal pressure all the layers of wire shall be equally strained and the tube shall have a given tension, and, at the same time, so that when the gun is at rest the compression of its bore shall not exceed a given amount.

Let
R_0 = radius of bore.
R_1 = outer radius of tube.
R_2 = outer radius of wire.
P_0 = maximum powder pressure.
T_0 = limit of tension of tube under strain.
T = limit of tension of wire under strain.
C_0 = limit of compression of tube at rest.
E_0 = modulus of elasticity of tube.
E_1 = modulus of elasticity of wire.

Suppose the wire wound upon the tube in the proper manner, and the structure in equilibrium under an internal pressure P_0, the inner surface of the tube having a tension T_0, and each layer of wire a tension T. At a point of radius r in the mass of wire the existing tension T is the combination of three strains—that of winding, that caused by the internal pressure, and that caused by the compressive force of the lay-

ers of wire outside it. The tension of each layer of wire being T, the radial pressure caused by the layers outside the point of radius r is evidently $\left(\frac{R_2-r}{r}\right)$ T, and, if we remove these layers, and apply in their place a radial pressure $\left(\frac{R_2-r}{r}\right)$ T, the structure will still be in equilibrium, the tension at r remaining unchanged. Now if we cause the internal pressure P_0 and the external pressure $\left(\frac{R_2-r}{r}\right)$ T, to vanish, evidently the wire at r will assume the tension at which it was wound, and then, if we find the change of tension at r caused by this removal of pressures, and apply this change to the tension T, the result will be the required tension of winding the radius r.

If the state of equilibrium of the structure is modified in any way, let

p_0 = resulting change of pressure at R_0,
p_1 = resulting change of pressure at R_1,
p_2 = resulting change of pressure at r,
t_0 = resulting change of tension of inner surface of tube.
t'_0 = resulting change of tension of outer surface of tube.
t_1 = resulting change of tension of inner layer of wire.
t'_1 = resulting change of tension of outer layer of wire.

We then have the following equations, given in Virgile's "Resistance of Metallic Tubes," and easily deduced from the equations of equilibrium of a homogeneous elastic tube:

(1) $$p_2 = -t_1\frac{r^2-R^2_1}{2r^2} + p_1\frac{r^2+R^2_1}{2r^2},$$

(2) $$p_1 = -t_0\frac{R^2_1-R^2_0}{2R^2_1} + p_0\frac{R^2_1+R^2_0}{2R^2_1},$$

(3) $$t'_0 = t_0\frac{R^2_1+R^2_0}{2R^2_1} - p_0\frac{R^2_1-R^2_0}{2R^2_1},$$

(4) $$t_1 = \frac{E_1}{E_0}\left(t'_0+\frac{p_1}{3}\right) - \frac{p_1}{3},$$

(5) $$t'_1 = t_1\frac{r^2+R^2_1}{2r^2} - p_1\frac{r^2-R^2_1}{2r^2}.$$

Combining (1) with (2), and (4) with (2) and (3), we have

(6) $$p_2 = -t_1\frac{r^2-R^2_1}{2r^2} - \frac{r^2+R^2_1}{2r^2}\left(t_0\frac{R^2_1-R^2_0}{2R^2_1} - p_0\frac{R^2_1+R^2_0}{2R^2_1}\right),$$ and

(7) $$t_1 = \frac{E_1}{E_0}\left[\frac{t_0}{3}\cdot\frac{R^2_1\left(2+\frac{E_0}{E_1}\right)+R^2_0\left(4-\frac{E_0}{E_1}\right)}{2R^2_1} - \frac{p_0}{3}\cdot\frac{R^2_1\left(2+\frac{E_0}{E_1}\right)-R^2_0\left(4-\frac{E_0}{E_1}\right)}{2R^2_1}\right]$$

Eliminating t_0, we have

(8) $$t_1 = \frac{3R^2_0 p_0(r^2+R^2_1) - r^2 p_2\left[R^2_1\left(2+\frac{E_0}{E_1}\right)+R^2_0\left(4-\frac{E_0}{E_1}\right)\right]}{\left[2R^2_0\left(1-\frac{E_0}{E_1}\right)+R^2_1\left(1+2\frac{E_0}{E_1}\right)\right] - R^2_1\left[R^2_0\left(2+\frac{E_0}{E_1}\right)+R^2_1\left(1-\frac{E_0}{E_1}\right)\right]}$$

To simplify (8), let $$a = 1-\frac{E_0}{E_1},$$

$$b = 1+2\frac{E_0}{E_1},\quad A = 2aR^2_0 + bR^2_1,$$

$$c = 2+\frac{E_0}{E_1},\quad B = cR^2_0R^2_1 + aR^4_1,$$

and we have

(9) $$t_1=\frac{3p_0R^{2}_{0}(r^2+R^2_1)-p_3r^2(oR^2_1+aR^2_0+3R^2_0)}{Ar^2-B}$$

also combining (1) with (5), we have

(10) $$t'_1=t_1\frac{2R^2_1}{r^2+R^2_1}-p_3\frac{r^2-R^2_1}{r^2+R^2_1}.$$

Now, eliminating t_1, we have, after reduction,

(11) $$t'^1=\frac{6p_0R^2_0R^2_1-p_3(Ar^2+B)}{Ar^2-B}$$

In other words, if the internal and external pressures undergo variations p_0 : the tension at the outer surface of the wire will undergo a variation t'_1, given b: tion (11); hence, in (11) putting $p_0=-P_0$ and $p_3=-\left(\frac{R_2-r}{r}\right)T$, we have

$$t_1=\frac{T\left(\frac{R_2-r}{r}\right)(Ar^2+B)-6P_0R^2_0R^2_1}{Ar^2-B},$$

and $T+t'_1$ equals the required tension of winding at radius r.

(12) $$T+t'_1=tr=\frac{\frac{TR_2}{r}(Ar^2+B)-2BT-6P_0R^2_0R^2_1}{Ar^2-B}.$$

We have now to determine the compression of bore caused by winding wire tension given above.

Suppose the winding to have proceeded t › a radius r. We wish to find the ‹ of tension of the bore caused by the application of a new layer of wire at tl sion t_r.

In (7) and (9) let $p_0=0$ and we have,

(13) $$t_1=\frac{E_1}{E_0}\left[\frac{t_0}{3}\cdot\frac{oR^2_1+aR^2_0+3R^2_0}{2R^2_1}\right]\text{ and}$$

(14) $$t_1=-p_3r^2\left[\frac{oR^2_1+aR^2_0+3R^2_0}{Ar^2-B}\right].$$

Eliminating t_1 and reducing, we have

(15) $$t_0=-6R^2_1\frac{E_0}{E_1}p_3\frac{r^2}{Ar^2-B}.$$

Now in (15) let $p_3=\frac{t_rdr}{r}$, the radical pressure caused by a single layer of wi: we have for the total compression of bore caused by winding to a radius R_2.

(16) $$C_0=6R^2_1\frac{E_0}{E_1}\int_{R_2}^{R_1}\frac{p_3r^2dr}{Ar^2-B}=6R^2_1\frac{E_0}{E_1}\int_{R_2}^{R_1}\frac{rt_rdr}{Ar^2-B}=$$

$$6R^2_1\frac{E_0}{E_1}\int_{R_2}^{R_1}\frac{TR_2(Ar^2+B)-r(2BT+6P_0R^2_0R^2_1)}{(Ar^2-B)^2}dr=$$

$$6R^2_1\frac{E_0}{E_1}\cdot\left[\frac{ABT+3AP_0R^2_0R^2_1-A^2TR_2r}{A^2(Ar^2-B)}\right]_{R_2}^{R_1}=$$

$$\frac{6R^3_1\frac{E_0}{E_1}(R_2-R_1)}{AR^2_1-B}\left[T-\frac{3P_0R^2_0R_1(R_2+R_1)}{AR^2_2-B}\right]=$$

$$\frac{2R_1(R_2-R_1)}{R^2_1-R^2_0}\left[T-\frac{3P_0R^2_0R_1(R_2+R_1)}{AR^2_2-B}\right].$$

These two equations (12) and (16) furnish the means of determining the tension of winding at any point and the compression of bore when the gun is after winding.

We have next to determine the thickness of tube necessary to fulfil the gi' ditions.

When the internal pressure P_0 acts, the pressure on the external surface of the tube is evidently $\left(\frac{R_2-R_1}{R_1}\right)T$, and we have, therefore, for the pressure that will strain the tube to a tension T_0,

$$(17) \qquad P_0=\frac{R^2_1-R^2_0}{R^2_1+R^2_0}\left(T_0+\left(\frac{R_2-R_1}{R_1}\right)T\right)+\left(\frac{R_2-R_1}{R_1}\right)T.$$

From these three equations, (12), (16) and (17), having R_0, P_0, T_0, C_0, and T, we are enabled to find R_1, R_2, and t_r, or the thickness of the tube, the number of layers of wire, and the tension of winding each layer.

In deducing these formulæ, one doubtful assumption has been made, the longitudinal tension has been neglected, or assumed to be uniformly distributed over the whole cross-section of the tube. This is not strictly true, but it is, in all probability, so nearly true that its assumption will have no material effect upon results.

In general practice the breech plug is housed in a jacket placed over an inner tube in order to lessen the size of the forgings used and to obviate the bad effects of the expansion of the bore upon the first threads of the screw-box. This will have no effect upon our results, however, for, having obtained the thickness of the tube, it may be divided into two parts, the outer of sufficient cross-section to take all longitudinal strain.

Almost always the tube will be of the same material as the wire—steel; in which case we have $E_0=E_1$, and (12) and (16) reduce to

$$(18) \qquad t_r=\frac{TR_2}{r}+\frac{2R^2_0}{r^2-R^2_0}\left(\frac{TR_2}{r}-T-P_0\right)\text{ and}$$

$$C_0=\frac{2\,(R^2_2-R^2_1)}{R^2_1-R^2_0}\left(\frac{R_1\,T}{R_2+R_1}-\frac{P_0R^2_0}{R^2_2-R^2_0}\right).$$

In this case, also, we can find direct values of R_1 and R_2, for, combining (17) and we have, after reduction,

$$R_2=R_0\sqrt{\frac{T_0+C_0+P_0}{T_0+C_0-P_0}}\text{ and}$$

$$R_1=\frac{TR_2+\sqrt{TR^2_2-R^2_0\,(P_0+T_0)\,(P_0-T_0+2T)}}{P_0-T_0+2T}$$

...ws, what must always be the case in a gun built of one material, ... depends directly upon the range of extension of the inner surface ... extreme compression to extreme tension, and can never exceed the the elastic limits of compression and extension.

...working of the formulæ deduced above is best shown by an example. We will the radius of the chamber of an all-steel gun to be 7″, the elastic limit of the ...f tube and jacket to be 18 tons, and the elastic limit of the wire to be 36 tons. ...h a construction having an elastic strength of 27 tons.

$R_0=7.$
$T_0=C_0=18$ tons.
$T=\quad 36$ "
$P_0=\quad 27$ "

To obtain R_2 and R_1 we have

$$R_2=R_0\sqrt{\frac{T_0+C_0+P_0}{T_0+C_0-P_0}}=7\sqrt{\frac{63}{9}}=7\sqrt{7}=18.5''.$$

$$R_1=\frac{TR_2+\sqrt{T^2R^2_2-R^2_0\,(P_0+T_0)\,(P_0-T_0+2T)}}{P_0-T_0+2T}=14.5''.$$

...e, therefore, must be 7.5″ thick, and, to secure a safe longitudinal strength, ...be divided into two parts, the inner, or tube proper, 3.5″ thick, and the ...jacket, in which the plug houses, 4.5″ thick.

...substituting in (18) the value of R_2 found and the given values of T, R_0, and P_0, $t_r=\frac{666}{r}+\frac{98}{r^2-49}\left(\frac{666}{r}-63\right)$, which gives the tension of winding as follows:

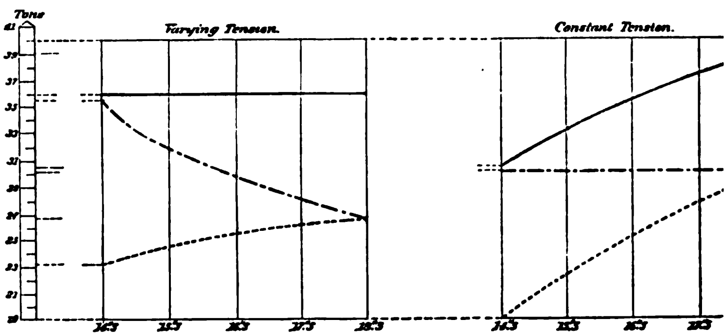
$r=14.5''$	$t_r=35.4$ tons.
$r=15.5''$	$t_r=32.6$ "
$r=16.5''$	$t_r=30.3$ "
$r=17.5''$	$t_r=28.5$ "
$r=18.5''$	$t_r=26.9$ "

To test our results we will substitute the values of R_2 and R_1 in (19);

$$C_0 = \frac{264.0}{161.25}\left(\frac{522}{33} \quad \frac{1323}{293.25}\right) = 18 \text{ tons, the value assumed.}$$

To illustrate the different strains produced by winding wire at a constant decreasing tension, the following diagrams are given. In the first the *dash* li the constant tension of winding (just sufficient to compress the metal of tl its elastic limit, 18 tons), the *dotted* line shows the state of strain of the w winding, and the full line that under an internal pressure of 27 tons. In tl the *dash* line shows the varying tension of winding, the dotted line the t te after winding, and the full line the state of strain under an internal pı tons

It will be seen that in the first case the pressure of 27 tons strains the oı of wire beyond the elastic limit of 36 tons, while in the second case no p wire passes the limiting tension.



The formulæ here deduced show the tension at which wire should be v order that a given internal pressure may result in equal tension throughout of wire.

It has, however, been thought by some that permanent set takes place nc when the force acting in any direction exceeds the elastic limit of the mate when the total extension in any direction due to all the forces acting excee tension at the elastic limit of the material.

On this assumption, made by Clavarino, in his investigations of the str hollow cylinders, the tension of winding wire should be such that under a ı ternal pressure each layer of the wire shall have not the same tension, but extension.

I have deduced formulæ based upon this assumption. They give a tension ing greater at the inner layer and the same at the outer layer as that give formulæ based on equality of tension, the difference being considerable in tl a great thickness of wire.

BREECH MECHANISM OF 10-INCH BREECH-LOADING RIFLE.

The mechanism for opening and closing the breech-plug of the 10-inch loading rifle is shown (Plates I and II) to illustrate one of the methods that to be adopted for guns of large caliber.

The plate *a* which is bolted to the face of the breech-plug is extende direction, and upon its outer edge is a geared rack in which a small pinion i the pinion shaft *c* bearing in the lugs of a bracket *d* which is bolted to the gı and is revolved by a double-acting ratchet winch *w*. This arrangement give increase of power, while it occupies only a small space.

NOTES ON SPRING-FIRING APPARATUS.

The Bureau has carefully considered the subject of spring-firing apparatu new guns, and has several designs of varying form, each having certain adv Sketches of those which seem to combine the greatest number of good points ı herewith:

Form No. 1, Plate III, is the first apparatus designed. It was intended t recess in the stem of the mushroom, and to secure in place by matched int

:te. III

Ordnance

June 1883

periment.

[illegible]

Chief of Bureau

RIFLE PROJECTILES.

32
1884

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

SIR: I have the honor to submit the following results of the firing trial of ogival-headed and four step-headed 3" steel projectiles.

THE TARGET.

A 1⅝" wrought-iron plate, 8′ 1" by 3′ 4", secured by four 1".5 bolts, backed by 20" oak, inclined at an angle of 14° to the line of fire, and distant from the gun (mean of impacts) 46 feet.

EXPERIMENTS.

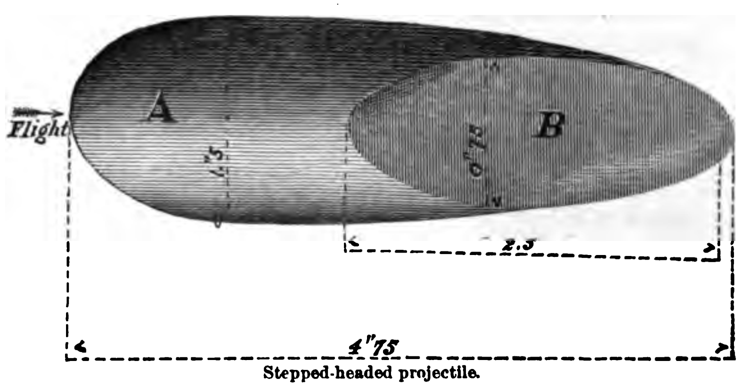
The jump of the carriage and the velocity of the various weights of projectiles being first determined, the several specimens were fired against the plate in the order from left to right in which they stand in the herewith inclosed photograph No. 1, ogival-headed, weight 10 pounds, striking velocity 906 f. s., striking energy (total) 56.98 foot-tons.

A score was cut of the following dimensions:

Length, 4".5; greatest width, 1".5; greatest depth, .25". The score offered no detail of particular interest, being that which experience has shown to be expected with the ogival form of head. Its depth is nearly equal to the best performance, that with No. 2.

No. 2. Ogival-pointed with one step, weight 9.5 pounds, striking velocity 911 f. s., striking energy 54.73 foot-tons.

The score was peculiar in character, showing two indentations, as may be understood from the following sketch:



Stepped-headed projectile.

Total length of score, 4".5; greatest width, 1".5.
Length of B score, 2".5; greatest width, 0".75.
Depth of A score, 0".125; depth B, 0".3.

It is evident from the positions of the two scores that the ogival point—at a side—and the step struck at nearly the same instant, the angle (with the axis of projectile) of the line in which both these points are found being that (13° 30′) which would lead one to expect such an impact. They thus mutually supported each other against penetration.

No. 3. Ogival pointed with two steps, weight 9.5 pounds, striking velocity 911 f. s., striking energy 54.73 foot-tons.

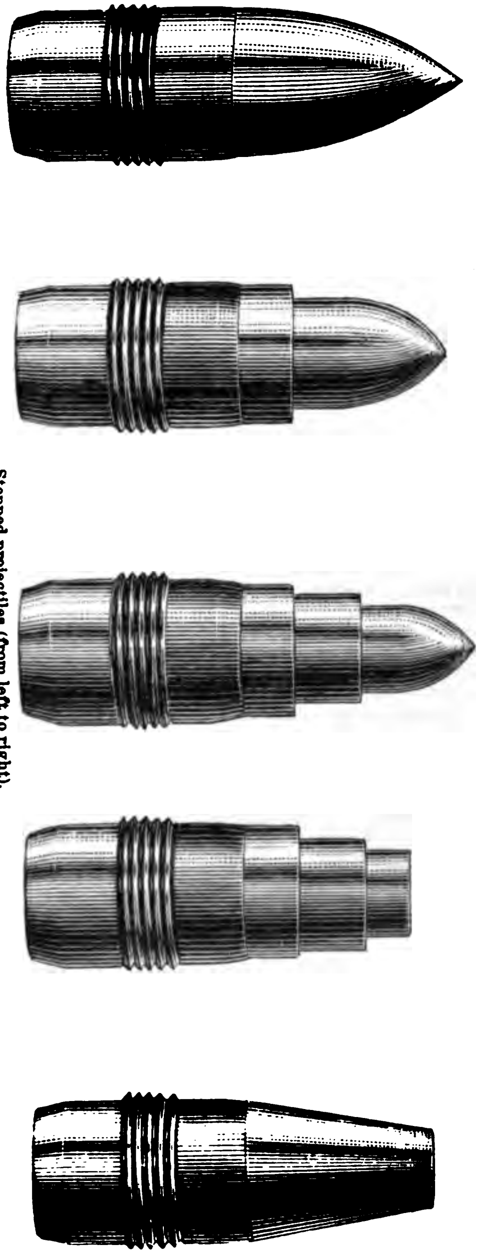
The score was precisely similar in character, and nearly equal in all dimensions to that of No. 2, viz:

Total length of score, 5"; greatest width, 1".5.
Length of B score, 1".75; greatest width, 0".75.
Depth of A score, ".125; depth B score, 0".25

The angle of the impinging points being again 14°, the third point of support, it seems probable, diminished the total work done by the projectile.

No. 4. Cup pointed with one step, weight 9 pounds, striking velocity 916 f. s., striking energy 52.30 foot-tons.

The score showed two distinct hollows in about the relative positions of the point, edge and step.



Stepped projectiles (from left to right).

It again seems evident that the impact of these two points was simultaneous, their angle 13.30° (as measured here) being nearly suitable to such action.

The *two* hollows are not sufficiently defined to furnish accurate measurements.

The total length of the score is 4″.25; the greatest width, 1″.5, and the greatest depth, 0″.15.

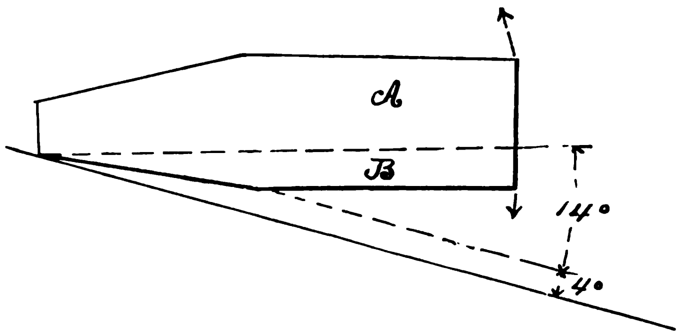
No. 5. Frustum of cone-stepped weight, 9.5 pounds, striking velocity, 911 f. s., striking energy, 54.73 foot-tons.

The score, of nearly uniform depth, has the dimensions:

Length, 5″; greatest width, 1″.25; depth, 0″.10.

It will be perceived that this is the poorest performance, the best being that of projectile No. 2.

It seems reasonable to believe that the following causes may be assigned to this defective performance:



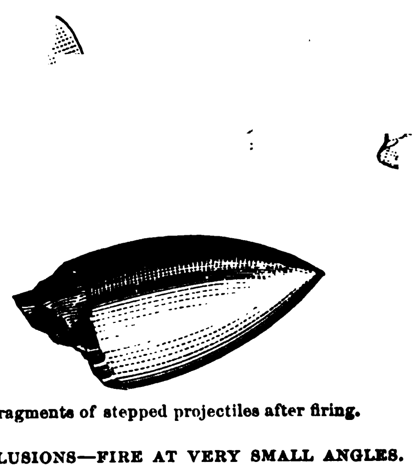
1st. That while the portion A of the projectile tends to turn to the left, the portion B assists the reaction of the plate, in its efforts *to the right*. 2d. That the decrease of the angle of impact by 10° (the slope of the head) assists the reaction of the plate, giving a direct bearing along its whole surface after very slight penetration.

The projectiles, without exception, broke up by the blow of the cylindrical portion upon the plate, the head having glanced.

The heads of all except No. 2 have been recovered, and a photograph of the poi which impinged will be forwarded to the bureau upon its completion.

All projectiles showed evidences of soft metal, the edges by the reaction of the plate *flowing upward toward the point* instead of downward.

The action upon No. 5 extends the whole length of the frustum.



Fragments of stepped projectiles after firing.

CONCLUSIONS—FIRE AT VERY SMALL ANGLES.

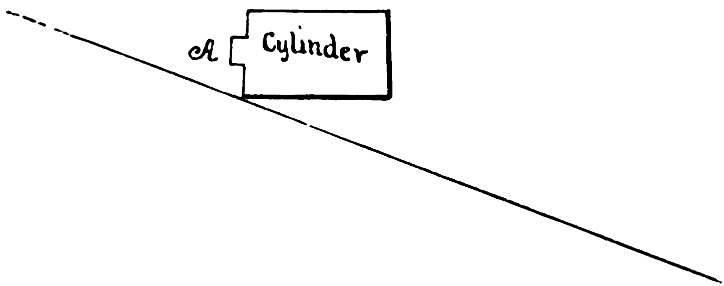
1st. That the energy, as great as may be, should be concentrated upon one biting edge at impact.

2d. The edges should not be cupped, they losing strength thereby to resist the reaction of the plate.

They should be hardened.

The projectile should be solid, the gain in left turning effect, due to diminution of radius of revolution, being probably greater than the disadvantage of the center of gravity nearer the base.

..llowing modification of the form of No. 2 is respectively submitted for the 's consideration:



tion being attained as far as the base of the flat-pointed stud A, the latter probably be of assistance in enhancing the racking effect, delaying the tend-o turn over with its shortened axis due to solidity.

olute penetration of plates of any great thickness cannot be expected at the -- angle used, if the backing be rigid.

latter was made so in this instance to reproduce the conditions of practice in e, and as it was expected that merely the biting effect was intended to be ---oped, uninfluenced by the greatly modifying conditions brought into action by g plates.

Very respectfully,

W. M. FOLGER,
Lieutenant-Commander,
Inspector of Ordnance, in charge Naval Experimental Battery.

t. MONTGOMERY SICARD, U. S. N.,
Chief of Bureau of Ordnance.

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

: I have the honor to submit the following details of some preliminary firing ..at the 1-inch Park compound plate.

piece used was the Hotchkiss revolver cannon of 37mm.

projectiles used were the standard Hotchkiss armor-piercing shell, and sharp ..lunt tri-faced projectiles manufactured at this station. The latter were tem-d, following the method employed with the steel bullets of the high-power musket.

e velocity of the projectiles was that fixed as standard in the French service to 411m), and in reaching this point I purposely began with a low velocity, 750 as (placing two 1" low (Chicago) steel plates behind the velocity screens) I ed to ascertain if practicable at what point the Hotchkiss projectile could resist king. It broke at all velocities with penetrations varying from 0".75 to 1".2.

a matter of comparison in effectiveness illustrated in th s preliminary velocity k, a blunt tri-faced projectile was used five times at all velocities employed, fur-ing penetration varying from 1" to 1".75. It is still serviceable, having been re-led for further use, and is unchanged in diameter. Its length has decreased 75. The wedge edges are unchanged

e plates used were the 1-inch oil-tempered and 1-inch water-tempered, backed by ak. Photograph A.

e round with each projectile was first fired against the oil tempered plate, as fol-:

otchkiss standard.—Penetrated 1".18 (point getting through into backing) and up.

..rp tri-faced.—Penetrated 1".5 and rebounded unchanged in dimensions.

*'unt tri-faced.**—Penetrated 1".5 and rebounded unchanged in dimensions. Radial k through hard facing extending 12" to right and above to bolt hole. Three ks from left of impact to edge of plate.

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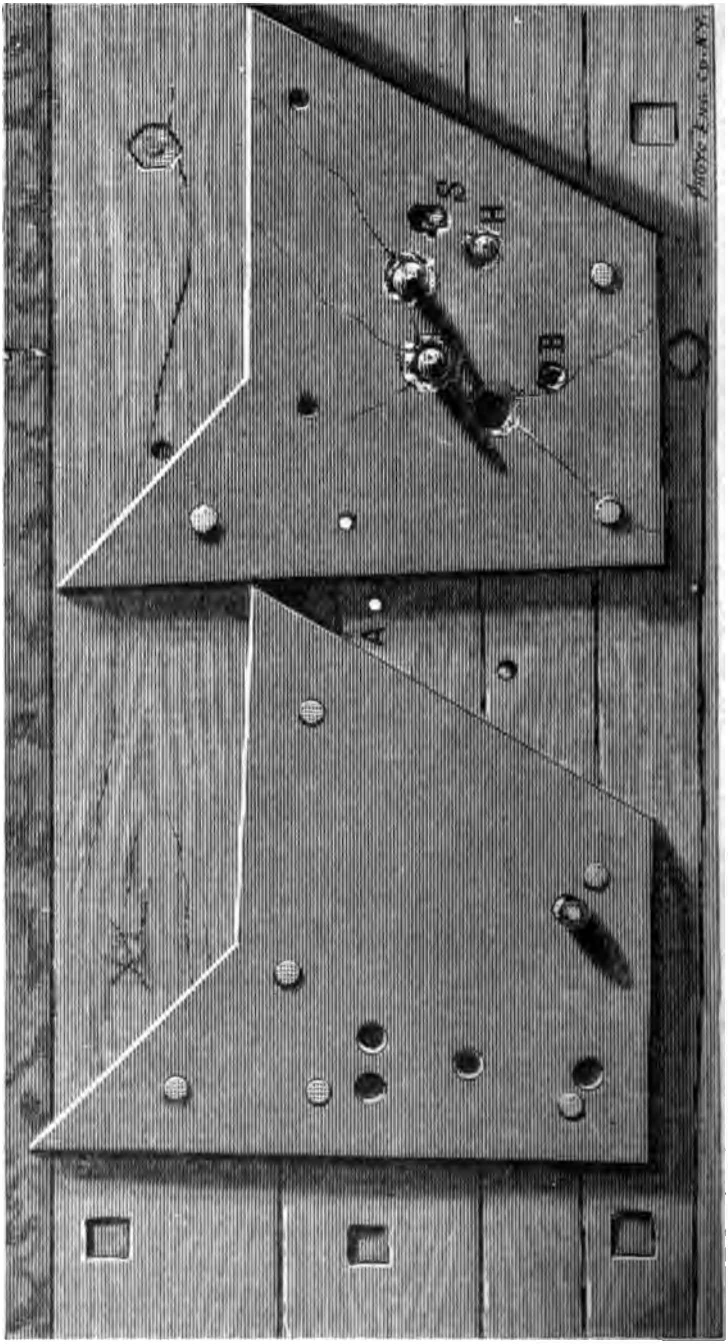
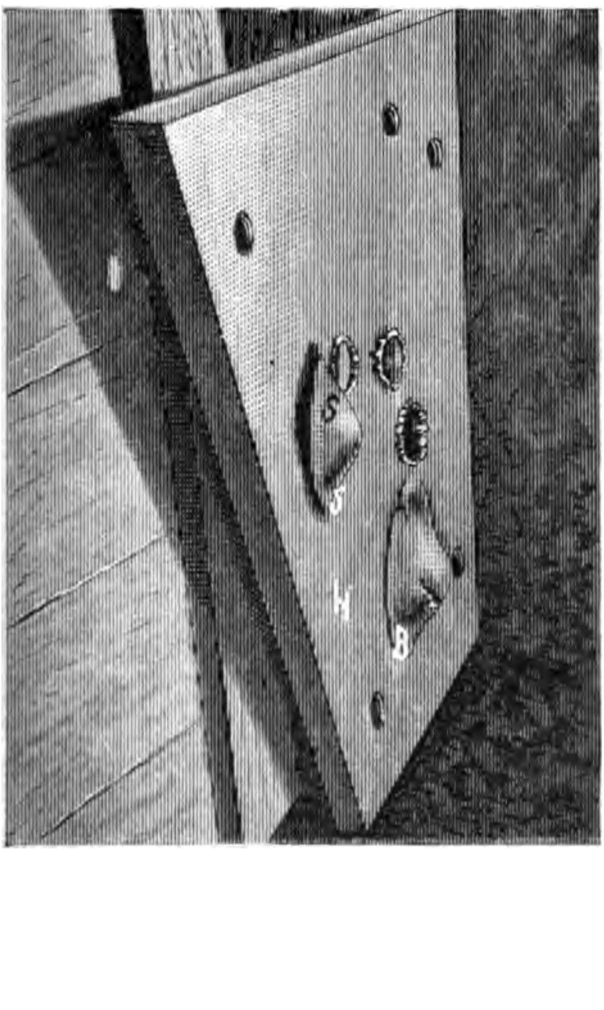
*Previously used against cast-steel carriage brackets.



A.—Exposed- ...ound steel plates.

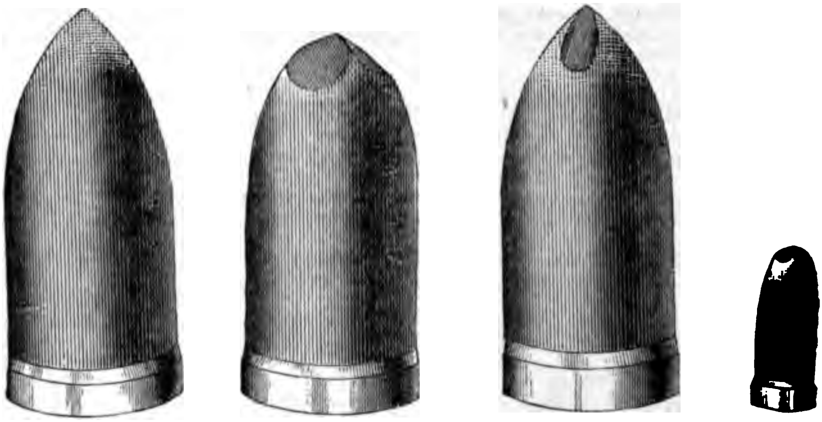
WATER-TEMPERED PLATE.

e rounds (one each projectile) were fired against this plate before it was dis-
l that, through an error at the Washington Navy-yard, the bevel for the bolt
ıad been placed upon the *soft* side of the plate. The latter was therefore re-
in these rounds.
penetrat ons were—
hkiss 1 .0.—Broke up.
p tri-faced 3″.—Spli backing, projectile unchanged.
t tri faced 3″.—Split backing, unchanged.
plate was then in poor condition, as the work had been done in the most un-
ble manner to the hard face.
ıck extended through the three impacts across its entire surface.
as turned about, and three other projectiles fired against it, with the following
.:
hkiss.—Penetrated about .6″ (point remaining in the impact) and pulverized;
r cracks about the impact, and bulge at the rear, but the plate was quite
red.
p tri-faced.—Pierced plate and penetrated .5″ into wood backing. Plate badly
. A disk of the soft steel back, 3¼ inches in diameter, was almost torn off.
ad of the projectile was, as it were, driven into the relatively softer cylinder
t breaking the latter.
t tri-faced.—The effects were nearly identical with those of the last round, the
this case being somewhat larger. Radial cracks in hard surface extend from
pact to bottom edge of the plate.
appearance of the plate at the rear is shown in Photograph B.

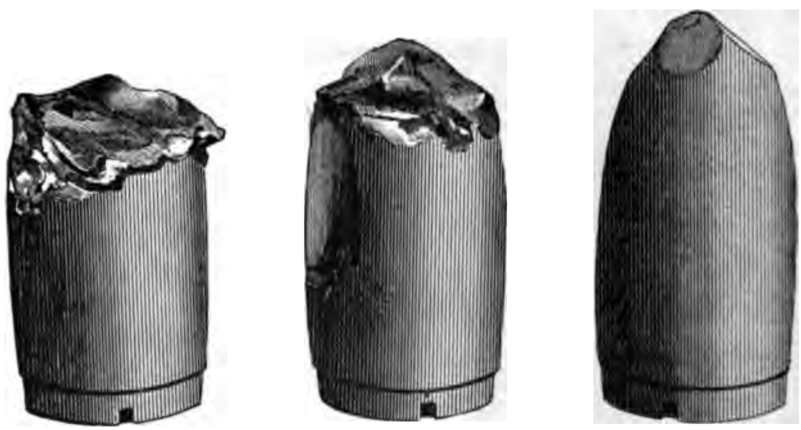


B.—Rear view of impacts, water-tempered plate. S, sharp tri-face; B, blunt tri-face; H, Hotchkiss.

The distortion of the two tempered projectiles is shown in Photograph C.



Hotchkiss and high-power musket projectiles.



No. 1. No. 2. No. 3.

C.—Nos. 1 and 2. Sharp and blunt tri-face respectively, after impact against water-tempered plate. No. 3. Clunt tri-face after having been used in five successive rounds against low steel with penetration varying from ¾-inch to 1¾-inch.

The third projectile is the blunt tri-faced, which has withstood the effects of five rounds, noted above.

The results of these experiments were so striking that I decided to suspend the work for the present, and request a further treatment of the remaining two plates.

It is a matter of considerable doubt as to which plate behaved the better. Opposed to the Hotchkiss projectile, the water tempered is greatly superior. To the steel-wedge heads it is inferior, though were the shells charged it is believed that with the greater penetration into the oil plate the effects might have been more disastrous to a target. The cracking was less with the oil plate.

It is probable (since the heat prescribed was for water tempering) that the oil plate was not sufficiently heated to furnish even a moderate hardness of surface.

It is therefore recommended that the 1″.5 and .5″ plates be returned to the Washington Navy-Yard, the former to be heated to a *cherry red*, and dipped in oil at 60°, or at temperature of air, the latter (since it is intended for experiments at acute angles) to be water tempered after the method previously authorized.

It is believed that the best shield plate will eventually be found to be a water-tempered compound, but it seems to be probable, from these experiments, that of the plates tried the back metal was too *high*.

l place valuable information at our disposition to order one more 1-inch ·third hard, two-thirds soft, and of same area as last order) of Messrs. Park, ., stipulating that the *backing metal* should be such as will take no temper, ; moderately affected as to hardening upon being dipped in water,
›ectfully, &c.,

W. M. FOLGER,
Lieutenant-Commander and Inspector of Ordnance.

ONTGOMERY SICARD, U. S. N.,
Chief of Bureau of Ordnance.

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

compliance with your instructions I have the honor to forward the follow- sion of the merits of various forms of head for armor-piercing projectiles ted with at this station, together with the conclusions reached by the ng trials. Details of these last, with the necessary sketches and photo- ›ve been forwarded to the Bureau, at the dates of the occurrence of the ich have extended over a period of about one year.

›e used in the majority of cases was the high-power musket, and latterly, limited way, the Hotchkiss revolver cannon of 37mms.

gets were of various plates, ranging in thickness from 0".5 to 1".5, backed ›ked, of ordinary wrought iron, of steel, representing specimens of the sides, l shields of the unarmored cruisers, and, lastly, specimen compound steel the manufacture of Messrs. Park, Brother & Co., of Pittsburgh, Pa.

THE PROJECTILES.*

rst of head were tried as follows:
or low angle impacts:
... of two calibers radius.
› tri-faced.
... tri-faced.
› angle impacts:
...ncated ogival flat-pointed.
Truncated ogival cupped.
Cylinders, stepped.
Cylindrical, flat.
Cylindrical, cupped.
ing now the several types in succession.

CLASS A.

Ogival No. 1.

d in your instructions, the governing idea of the experiments was, that ·apid development of the gun and armored target in recent years, the pro- l been neglected, the universal experience being that there is a loss of use- › from breaking up or distortion.

ppeared that the ogival was the development of a punching tool to be used latively soft material, and that with the advent of hard or tough armor it l to be weak at the point, and of limited wedge power. The six-inch caliber l in giving dimensions. It will be observed that the ogival possesses the features:

ting angle, that inclosed between the axis and the tangent to the curved ; the point, and below which it will not *bite*, properly speaking, is 41°.

.—The cross-sectional area, at any distance A C† from the point, is 8.66 ›hes. At a distance A B it is 3.40 square inches.

›sses in its profile no feature which will induce rupture (in a target plate) ne point than another.

Sharp tri-faced No. 2.

g angle at three points, 39°.
·emaining three points there is a wedge of variable angle, dependent upon of impact.

---

*Manufactured at this station. † *Vide* sketch.

The cross-sectional area at distance A C is 12.6 square inches; at A B 5.12 square inches.

Excess of strength over ogival at the distance A C, 3.94 square inches; at A B, 2.32 square inches.

Blunt tri-faced No. 3.

Similar in method to No. 2. Limiting angle, 50°. Cross-sectional area at A C, 14.12 square inches; at A B, 8.66 square inches.

Excess in strength over ogival at the distance A C, 5.46 square inches; at A B, 5.26 square inches.

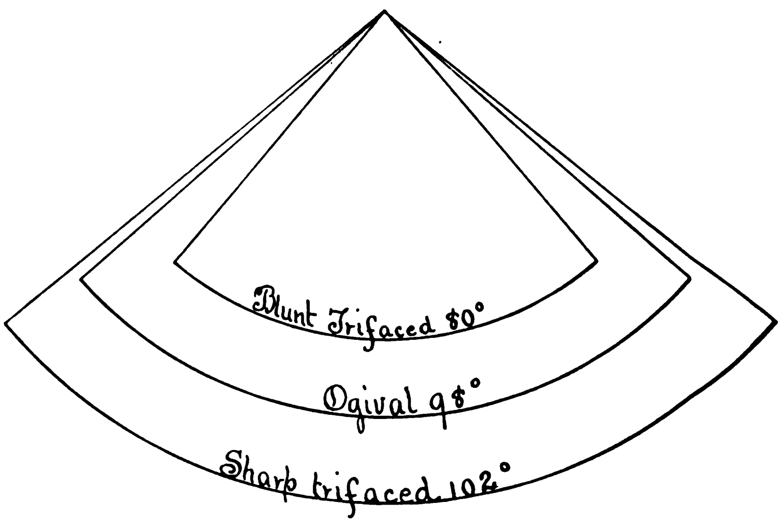
Excess in strength over sharp tri-faced at A C, 1.55 square inches; at A B, 2.94 square inches.

The object of the three faces of the last two-named classes is at once apparent, they furnishing for the modern hard-faced armor a triangular wedge to induce cracking—perhaps the sole defect of such armor.

The sharper point is considered as better adapted for general naval purposes.

The blunt point, with its greater strength, is found more effective against compound plates for normal or low-angle impacts, and might be best applicable to those cases where the choice of position is at the disposition of the commander, as in the bombardment of an armored fortification.

The angles of effectiveness are illustrated in the following diagram:



It is evident that a further advantage lies with the tri-faced systems, remembering that with equal velocities at impact the penetration of these is invariably greater than of the ogival, in that, with *equal* penetration, there will remain less work to break through for the tri-faced type, it having less metal before it than its rival, due to the greater volume of the head. There is thus a gain in two directions.

As you are aware, these theoretical considerations have been abundantly verified by the firing trials.

CLASS B.

Forms suitable for acute angles of impact.

Truncated ogival flat No. 4.

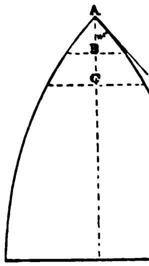
Is serviceable up to 25°, its limiting angle with the dimensions used.

The curved shoulder behind the edge has a very decided action in assisting the projectile to "score out."

Truncated ogival cupped No. 5.

This projectile proved less effective than the flat point of the same body profile, development of heat at impact (the high-power bullet striking with an energy about 1.5 foot-tons), being sufficient to *draw* the temper of the relatively thin edge, then broke down, destroying the biting quality.

1



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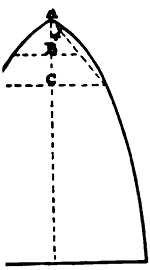

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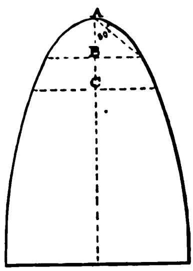

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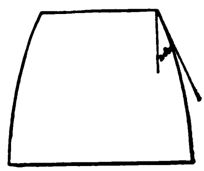

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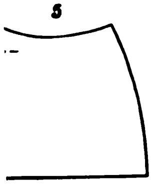

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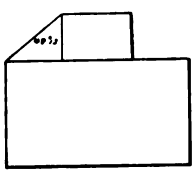

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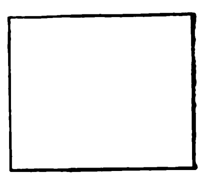

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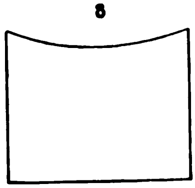


Stepped cylinder No. 6:

Was designed to furnish means for avoiding the overturning action assumed to c tain with a true cylinder. It was found to be weak in cross-section of step, the h breaking off at impacts between 30° and 40° and if increased in strength to be dis vantageous in presenting another point of bearing at (shortly after) impact. At ac angles (below 25°) there is found to be slight probability of capsizing with "hi power" energy, and further with the usual length given the true cylinder.

Cylindrical flat No. 7.

If of suitable temper, and of equal or greater hardness and toughness than the pl against which it is fired, this projectile will bite effectively at very acute angles.

Cupped cylinder No. 8.

Presents the defect as to drawing the edge temper of No. 5 cupped truncated ogi noted above.

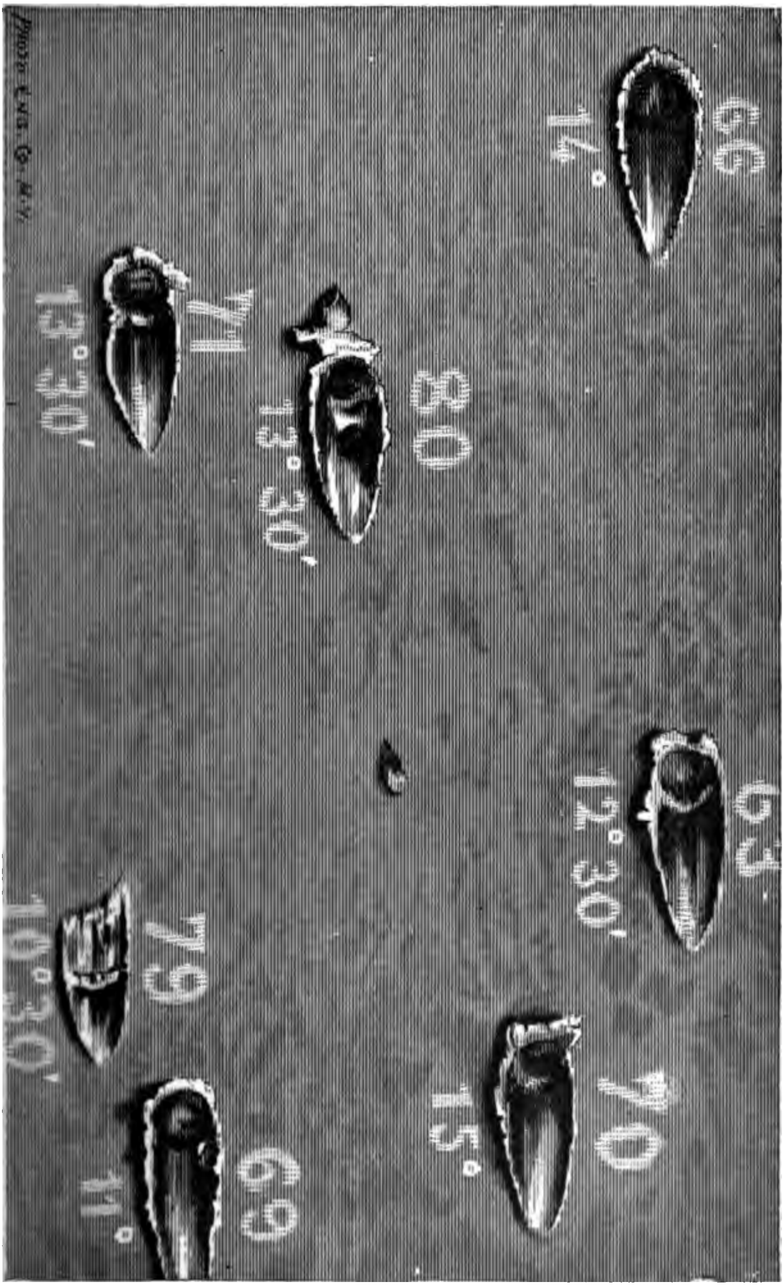
In compliance with your supplemental instructions, experiments are now in pr ress using larger calibers with the types of head found most promising.

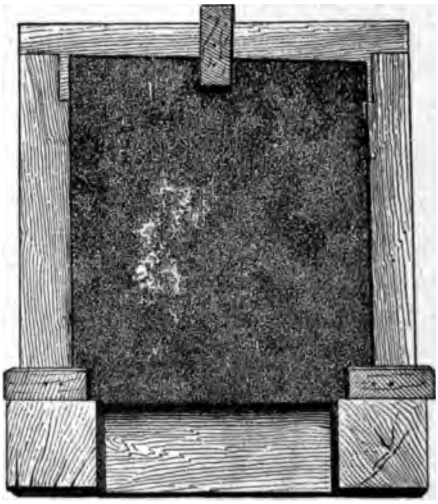
Respectfully, &c.,

W. M. FOLGER,
Lieutenant-Commander, Inspector of Ordnance,
in charge Naval Ordnance Proving Groun

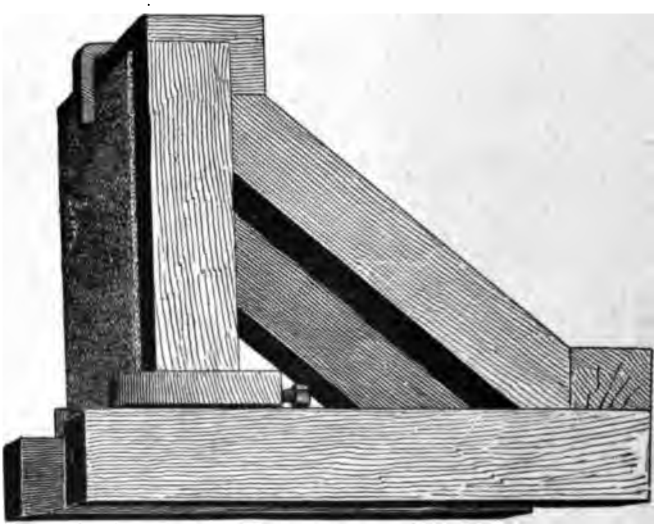
Capt. MONTGOMERY SICARD, U. S. N.,
Chief of Bureau of Ordnance.

50-calibre steel bullets used in armor experiments with high-power musket.


66
14°
71
13°30'
80
13°30'
63
12°30'
79
10°30'
70
15°
69
11°



Front view of target used in armor experiments with high-power musket and Hotchkiss revolving cannon.



Side view of target used in armor experiments with high-power musket and Hotchkiss revolving cannon.

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

SIR: With the idea of utilizing the volume of the bore of a small-arm in the consumption of the charge to better advantage than obtains in the service conditions of 70 grains of fine-grained powder, with 405 grains of projectile, the following preliminary experiments have been made at this station:

The chamber of the Remington rifle, caliber .50, the system now withdrawn from the naval service, was lengthened to a volume which would contain a charge of about 12 grams (185 grains) of powder.

Cartridges to fill this length were constructed by adding a paper cylinder of suitable length to the normal shell, the bullet being simply placed on the powder, which nearly filled the case of brass and paper.

The velocity and recoil of the (old) service cartridge of 70 grains of powder and 450 lead being previously determined (10 rounds) to be 1,250 f. s. and 3″.9, various charges of the following powders were used, gradually increasing the weight of the charge to note the progressive effect on velocity and recoil, viz:

No. 1, sph. hex. (1790-123) broken up and sieved through 0″.3 and on 0″.15.
No. 2, sph. hex. sieved through 0″.15 and on 0″.06.
No. 3, sph. hex. sieved through 0″.06 and on 0″.05.
No. 4, Hazard cannon, old sample in store.
No. 5. Schaghticoke mills cannon, old sample in store.
No. 6, Du Pont musket, and
No. 7, Hazard musket (sporting electric No. 3), 12 grams (185 grains), of Nos. 1, 2, 3 gave practically the same results, about 1,400 f. s. and 4″ recoil.

No. 6 gave 1,550 f. s. and 4″.2 recoil; No. 7 gave 1,600 f. s. and 4″.2 recoil.

The recoil in the last-mentioned trials being excessive, an endeavor was then made to construct a progressive charge. It also seemed apparent from the action of the piece that the blast of the primer had a tendency to, in part, pulverize the charge before combustion and produce, as it were, a sort of detonating effect, instead, as was desired, a progressively increasing combustion.

Cartridges were therefore made up of Nos. 4 and 5 at the rear, and Nos. 6 and 7 in the front, in varying quantities of each, with a diaphragm of tissue paper between the granulations to prevent their intermixture. A gain in ballistic effect was at once apparent, the velocity rising with the decrease of coarse grain and increase of fine grain until the ratio $\frac{11 \text{ musket}}{5 \text{ cannon}}$ (Hazard's) in grams was reached, recording a velocity of 1,830 f. s. with 3″.9 recoil.

The supply of Hazard rifle being exhausted, there having been originally on hand a small canister for sporting purposes, I requested Messrs. Du Pont to send me a small sample, giving them characteristics. Mr. Eugene Du Pont promptly sent me the desired granulation, with which the experiments were continued, obtaining finally a velocity of 1,880 f. s. with 3″.9 recoil.

Several shots were fired for accuracy at 100 yards in comparison with the normal chamber, giving results at least 50 per cent. more favorable with the high-power gun. The iron target against which the velocity records were made furnishes striking evidence of the energy of impact in these experiments, the indents made by the leaden projectiles being frequently 0″.25 in depth.

There is necessarily an escape of gas at the rear, the brass shell no longer being a perfect gas check with 50 per cent. of the charge placed in advance of its front edge, which causes a lack of uniformity in the results. For this reason the piece has been fired with a lanyard, the operator taking shelter. It is evident there would be a large gain in power with a properly constructed gas-checking shell.

The Bureau will doubtless remark the slight recoil observed. Whilst the method of recording this feature leaves something to desire—the gun recoiling freely on the slide—I think the shock will not be found to be too great when the charge question can be definitely settled in a properly constructed piece. I believe that whilst the energy of recoil will doubtless remain, that due to the high velocity of projectile, the method of its application to the shoulder will be greatly modified; that it will partake of the nature of a shove, rather than a blow, as at present, and perhaps be less of a shock to the nervous system than at present.

I inclose herewith two sketches by Ensign McLean of a cartridge (.45 caliber) containing 202 grains of powder charge.

I prefer that of larger diameter, as being likely to produce better results, but hesitate to recommend it, as its manufacture will necessitate the greater outlay in the manufacture of the piece and cartridge shell.

The Remington system seems best adapted for the long shell from the position of the hammer in insertion, expense only considered, though otherwise one of the bolt systems would be preferable. The power and *throw* of the Remington extractor may prove insufficient; the former (power) may possibly be increased sufficiently by augmenting the length of the breech-block thumb-piece.

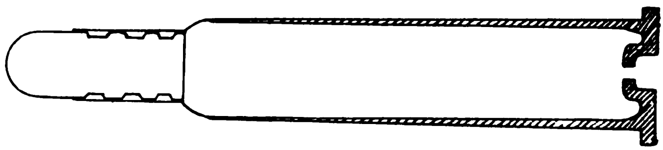
The model sketch selected by the Bureau will serve for making the "blank" (dimensions being given) by which the Remingtons or Springfield can bore the chamber.

The weight, 10 to 11 pounds, is respectfully suggested for the experimental gun, should the Bureau decide to have one built. An increase of 0''.3 in total diameter of breech (.45 caliber) for a length of 4'' would seem to furnish sufficient strength.

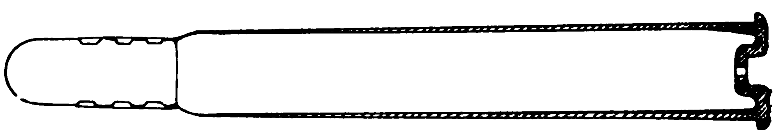
The breech-block (or bolt) and supports of whichever systems selected by the Bureau should be slightly strengthened.

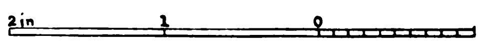
* * * * * * *

N° 1.



N° 2.





12
1884

SIR: Since my report of August 28, No. 24, a large number of rounds has been fired from the .50 caliber Remington musket with an enlarged chamber, using a [illegible] of 185 grains of powder of special granulation, reproducing the high velocity [illegible] f. s.) previously recorded.

The cup gas check, containing the primer (the head of a standard cartridge shell) suggested by the Bureau, was used, and checked the gas fairly well.

On account of the probable weakening of the breech and of the barrel it has not been considered safe to fire the piece from the shoulder, although the distress from the recoil—which last, as before stated, is doubtless that consequent upon or rather accompanying the increased velocity—would probably not have been too great, owi[ng] to the method in burning of the charge, and the fact that the weight of the project[ile] remained constant.

Firing from the shoulder was further attended with a certain risk, the cartridge head not invariably checking gas.

There was experienced a difficulty in obtaining uniformity in results, owing to the fact that the standard .50 caliber projectile has no patch, and that the amount of lubricant upon its surface varies, and thus its diameter producing a lack of uniformity in the *density of charge*, the projectile not reaching the point at the forward slope without varying friction.

To eliminate this difficulty (as well as in connection with experiments with another form of bullet), patched projectiles were used, which, besides modifying to a certain extent the difficulty in question, illustrated the well-known advantages in patching.

The following conclusions may be deduced from the entire series of experiments on the subject:

It does not seem probable that there would be any benefit, or further development in the principles which govern the action of such a piece, in making a special barrel in which the same system of breech gas-checking is employed. There is a doubt about its effective performance as a gas check which would imply a risk in use at the shoulder, a feature which should be tested in the experimental gun. The section of the chamber proposed being probably greater than that of any cartridge in use in this country, special tools would be needed for the manufacture (stamping or "spinning") of the gas checks, as it is not probable that steel or iron turned to size in so small a circumference would prove effective.

The difference in cost, therefore, between this method and that proposed of making long shells at once, would probably prove too great, in view of the disadvantages of the first mentioned, already well established.

The powder question in a high-power small-arm needs considerable experimental development, and this can only be satisfactorily accomplished with conditions where the density of charge is under control, as is the case where a shell is used in which the bullet may be crimped at any desired point. I have little doubt that a powder can be developed here which, in the increased quantity demanded, will burn within the barrel and produce the effects desired.

I venture to suggest, for the Bureau's consideration, the desirability of using patched bullets in this piece, which, acting as does the forced band in heavy ordnance, enables the entire energy of the charge to be utilized in a proper manner, which clearly is not the case in the present .45 caliber standard bullet.

It also seems probable that the heating effect, so frequently reported in service, and due in large measure to a portion of the solid products of combustion aggregating near the muzzle (where, being more rapidly cooled, there is a greater deposit), and further, the "leading" of the barrel, would be advantageously modified by the use of the superficially lubricated patch. Its advantages in accuracy are clearly apparent in its employment in nearly all target and sporting rifles.

It also seems evident that the present method of rifling small-arms can, in imitation of that found to be best for great guns, be profitably changed to the poly-grooved system, the rotating force being thus applied at a greater number of points, with a consequent diminution in local strains and distortion of the cylindrical portion of the projectile, and, perhaps, also of recoil.

The piece proposed, therefore, will be—

1. The chamber space, the dimensions of the barrel at the breech, and the weight of the piece, those recommended in my letter of August 28.

2. The bore to be provided with a projectile slope, as in the case of large guns, and, like them, poly-grooved.

3. The barrel to be increased as much as possible in thickness—within the limits of final weight—in order to eliminate, as far as possible, (barrel) vibrations.

4. The bullet to be patched.

The selection of the breech-closing system most suitable cannot well be decided upon without consultation with the manufacturer, who may (in case the Bureau should approve) be charged with the fabrication of the experimental cartridge shell.

I extract from the American Field, newspaper, the weights of piece, charge, and projectile used in late English sporting target trials—the results of which were published since my last letter on this subject—which well illustrate the direction of development abroad.

Table—(Double rifles.)

Maker.	Gun.	Weight of charge.	Projectile.	Ratio charge of projectile.
	Pounds.	*Grains.*	*Grains.*	
Jefferies	8.25	138	340	1-2.6
Holland	11.6	164	508	1-3.6
Adams	10.8	164	507	1-3.09
Bland	10.2	164	512	1-3.1
Bland	10 8	164	512	1-3.1
Watson	9.7	164	501	1-3.05

51
1884

SIR: During the past month, as other work has permitted, the following experiments have been made with steel projectiles in the .50 caliber, high-power rifle.

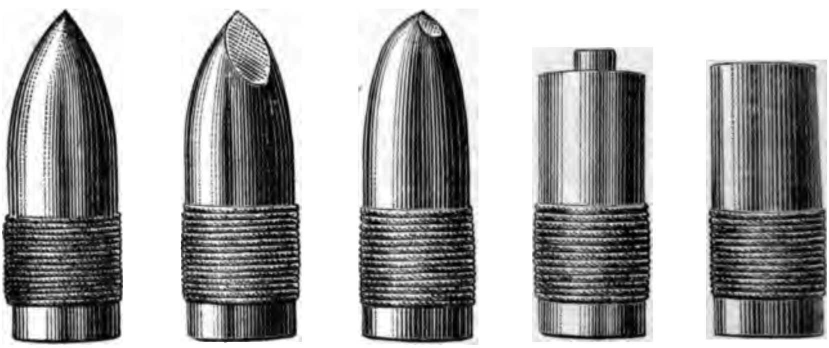
The objects of the experiments were, principally, features which have been discussed with yourself from time to time, or referred to in various letters from this station.

They were—

1. The employment of steel for musket-caliber projectiles.
2. The experimental determination of an effective profile of projectile head for both direct and inclined fire.
3. The determination, within the limits of our facilities, of the treatment.
4. The firing test of the impenetrability of both tempered and untempered thin compound steel plates on the manufacture of Messrs. Park, Brother & Co., of Pittsburgh, Pa., recently described to the Bureau in my No. 21.

MANUFACTURE, TREATMENT, ETC.

The projectiles, of (crucible) tool steel, were turned to size, and in the first instance given a weight of 450 grains and tempered, as will hereafter be described. A band of thread was wound about the cylinder over the center of gravity, to impart rotation. (*Vide* Photograph A.)



A.

These projectiles, without exception, tumbled and broke up against an iron plate, being of too great length for the pitch of the rifling. A second attempt was made with a shorter projectile, provided with a leaden band at the base. It proved also too long, and it was further surmised, from the character of the impact, that the center of gravity was too far to the rear.

A third trial was made, with a brass cup pressed over a suitable score at the base (jogged to prevent rotation about the cylinder) and turned down to a profile similar to that of experimental band No. 1, allowing a *forcing* over bands of 0".0075.

The step was slightly deeper at the forward end, which, with the pressure of firing and that upon the base, held the cup on satisfactorily. (*Vide* Photograph B.)

B.

There were but three cases in upwards of thirty rounds of defective action in flight, which were presumably due to lack of care in centering the cup.

projectiles, Class A was the simple ogival, struck with a radius of two

B, tri-faced, of the profile recently recommended in a 6-inch armor-piercing), a modified ellipse.

, similarly tri-faced, but of blunter point and of pure elliptical profile. This ion was adopted as possibly producing, with its abrupt shoulder, a greater t in the hardened steel plate.

, a simple square-headed cylinder.

E, a stepped cylinder, the flat point being of a diameter one-third that of the and one-tenth inch in height.

THE TARGETS.

ets, placed at 95 feet distance from the muzzle of the piece, were—

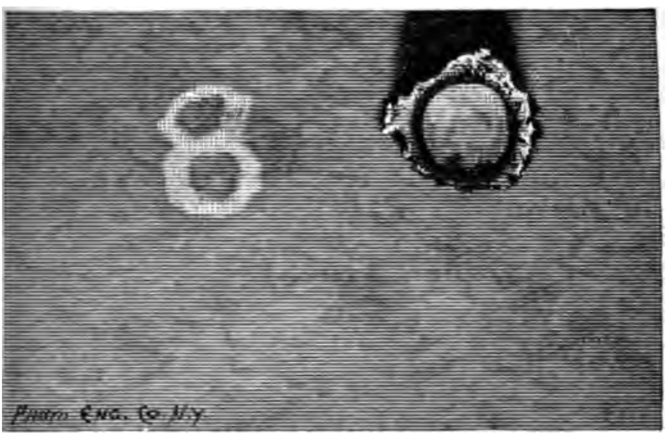
ought-iron plate 1 inch in thickness.

untempered compound hard and soft steel plate one-half inch thick, 12 by es.

tempered compound plate similar in size and quality to No. 2.*

lts: Detail of firing trial. The wrought-iron plates were penetrated nearly well by classes A, B, and C, the slight difference in each case being, how-or of the tri-faced specimens. A single exception in upwards of 30 rounds number 25 upon hardened steel. (*Vide* Photograph C.)

est record in wrought-iron is that of No. 8, Class B (at its second trial), being tration the entire length of the projectile, with the most developed rupture at r. (*Vide* Photograph D and D^a.)



D.

nhardened steel plate was pierced equally well by the three classes.

ardened plate is practically impenetrable, sustaining no damage whatever gle impact, in a clear space, of either class.

reatest penetration and bulge in the hardened plate were furnished by No. 26, . (*Vide* Photograph C.)

plate possesses an extremely valuable feature or quality, recognized in the chilled castings, of localizing the impact effect, there being no cracks apparent large number of shots had been fired in close proximity (of impact) to each A single case is noted in the firing record. It is possible that repeated blows small area may jar off a portion of the hard face, but this is extremely im-e in service work.

ojectile broke up upon direct impact with iron or unhardened steel. All pro-broke up at direct impact with hardened steel.

e inclined iron plate the specimens of Class D (plain cylinder) remained un-whilst of those of Class E at least one broke (being subsequently picked up, otograph E), and considering the similarity of the impact in the two cases—aph F—it is probable the other was also broken.

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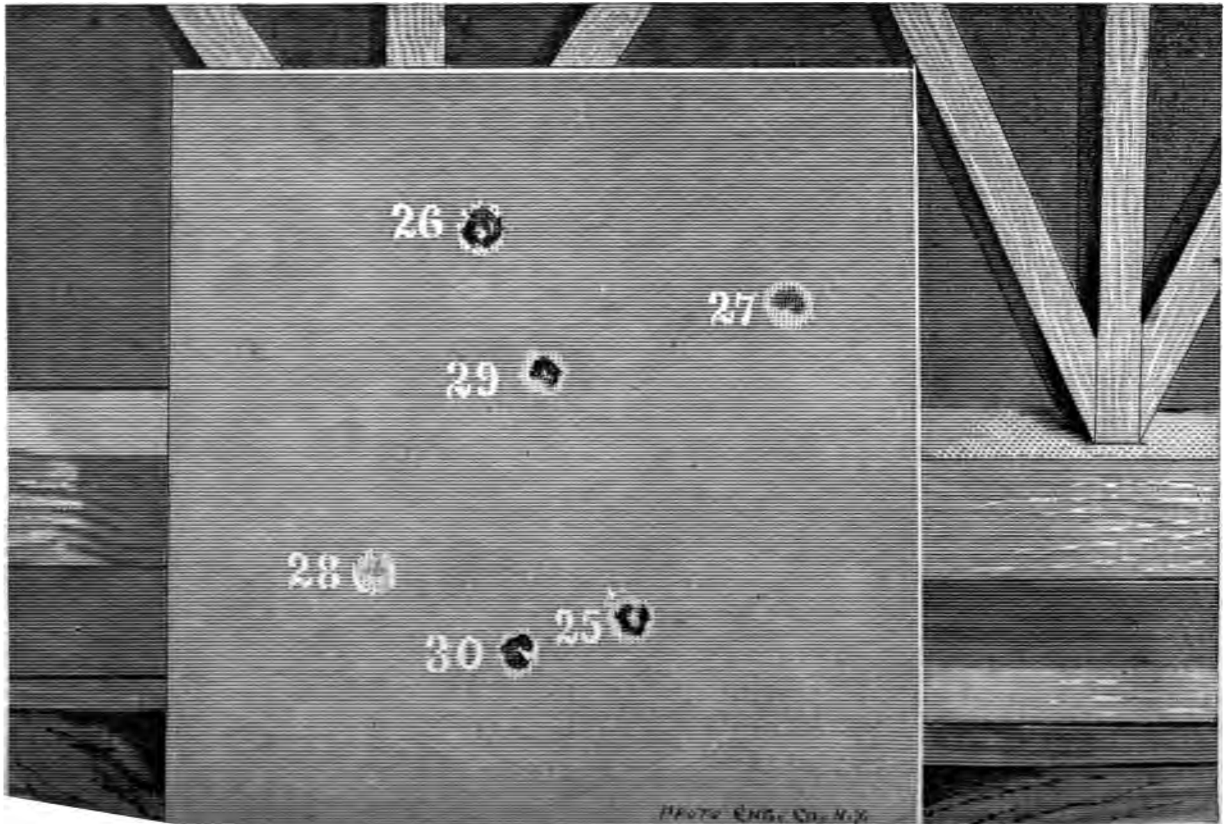
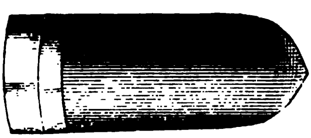
get No. 2 was hardened in water after a limited number of rounds. Both ven me by P., B. & Co.



a.

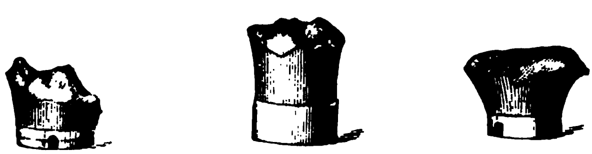
Dª.

cimen of E picked up evidently broke by the force of the strains between u and the cylinder, the indications of the initial impact being distinctly ap- upon the unbroken side of the cylinder. In spite of the rupture, the greater to the plate was effected by class E stepped. There was no difference be- the impacts Nos. 21 and 23.
tra round, not recorded, was fired at hardened steel. The projectile (Photo-) was given a hemispherical head, was tempered as hard as possible, and left



G.

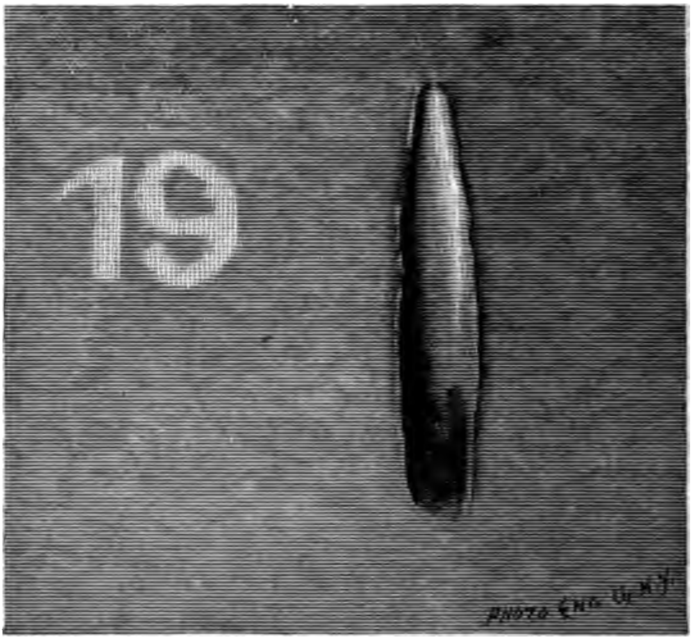
rn. It broke into a great number of pieces without rupturing the surface skin plate or making a perceptible (to sight) indent. As will be noted in the firing a round was fired with an untempered projectile, ogival-headed. The result almost complete flattening of the bullet, the plate being quite unaffected. aph E.)



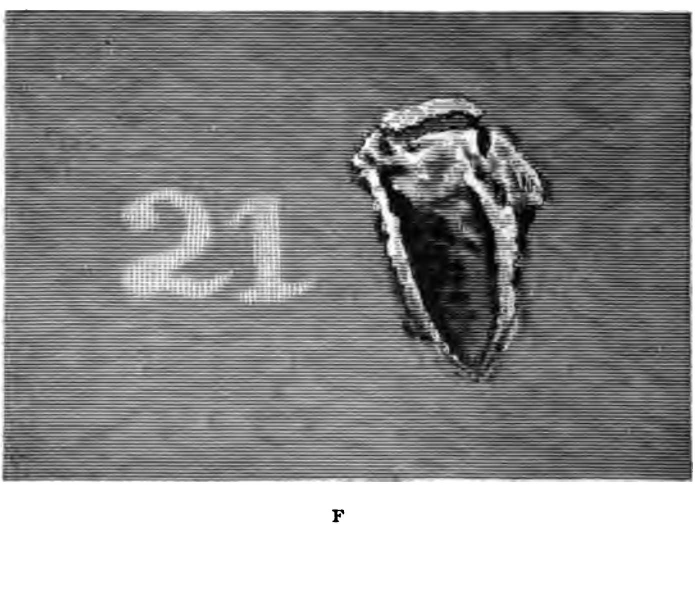
E.

Projectiles numbered 29 and 30, with hardened points only, presented interesting features (Photograph F), in that the "low" cylinder was apparently driven up around the hard ned point.

As will be remarked, several projectiles were used twice, their dimensions, after the first round, being quite unaltered



F.



F

F.

CONCLUSIONS.

lieved that the cup band above described is a perfectly feasible method of **rotation to a** steel projectile of musket caliber, and, this being established, **of the increased** power and destructiveness which may be utilized in high-**chine guns** of musket caliber and high-power muskets, as applied in use **ht shielded** batteries or unarmored vessels, will be appreciated by the **thout further** comment.

ults enumerated being taken as a basis, it seems probable that with the **musket** recently submitted to the Bureau, a muzzle velocity of 2,200 f. s. **ained** with a solid steel projectile 3.5 to 4 calibers in length, which should **etration in** wrought iron of 1″.5.

seems probable that the sharp pointed tri-faced projectile of the modified **profile, and** the blunt tri-faced of pure elliptical head, will furnish a better **nce, respectively**, against wrought-iron and steel-faced plates than the

trials with these at direct impact are respectively recommended.

recommended that trials be made against plates inclined at various angles, **he biting effect**, as compared with the ogival head.

lieved that the flat point of the cylindrical stepped projectile, made lower **with a rounded** junction with the main cylinder, will furnish a performance **ll more distinctly** surpass that of the plain cylinder.

It will be appreciated by the Bureau that the hardened compound steel plates of Messrs. Park, Brother & Co. possess valuable qualities for machine and great-gun shields, and for torpedo-boat sheathing. Its value in impenetrability as compared to wrought iron is apparently about 3 to 1.

I will venture to suggest the probable value of experimental firing against plates of this description of thickness, ½ inch to 1.5 inches, using the Hotchkiss revolvi cannon of 37 mm.

* * * * * * *

103
1884

SIR: I have the honor to submit herewith the record of the trials of steel bullets o various profiles against the specimen steel plates from the sides, decks, and machin gun shields of the new cruisers.

The object of the experiments was:

1. The development of suitable temper conditions for armor-piercing projectiles.
2. The thickness of plate at various angles which may be pierced by the ste bullet.
3. The determination of the character of *pointed* head (of projectile) most effecti for angles of target above 40°, or about the "limiting angle" of the ogival of tı calibers radius.
4. The determination of the shape of head of greatest biting effect at angles l low 40°.

The details of each round are given in the firing record.

Best results in each series are indicated by a red arrow.

SUMMARY AND CONCLUSIONS.

It will be perceived that the half-inch plate (side plating of "Chicago," "Bostoı and "Atlanta") was pierced by both sharp-pointed classes (A and B) at all angles l tween 45° and 90°, inclusive.

The penetration at normal into the inch plates (due entirely to improvement temper conditions) is considered remarkable, nearly equaling the previous perfor ance into wrought iron.

It being assumed that in comparing projectiles of Classes A and B the effects normal would hold good for all angles between the "limiting angle" and norm firing was only done at these limits.

The conclusion reached is that the sharp tri-faced head B is superior to the ogi at all angles above 50°, and its equal at angles between 40° and 50°.

Against soft armor the blunt tri-faced C is superior to the ogival at angles abc 60°.*

It will, without doubt, fall behind the ogival at angles between 60° and 46°, d to the large angle (with the axis) of its faces.

As observed in previous experiments, as well as is indicated in rounds 88, 89 *et s* its chief merit will be found in direct, or nearly direct, impact with compound, h faced armor.

Against plates at low angles it will be observed that all classes were distanced the rather remarkable performance of D, which bit exceedingly well at 11°. T flat-pointed truncated cone fell behind at once, the rise of the shoulder behind edge assisting to score out.

The cupped specimens failed definitely as compared with Class D. It is believ judging from its appearance and the action of a file upon a cupped edge after firi that the heat of impact "draws" the temper of the comparatively thin metal at t point, which is then torn off, permitting the projectile to be thrown out.

It seems well established that Class D, if of suitable temper, will bite unharder armor at all angles above 10°, and, although the effects upon plates of moderate thi ness will perhaps be slight, there seems to be no reason why (remembering that w larger calibers the ratio of projectile energy to capacity of plate is greatly mı plied) it should not bite well at all angles below 10°.

The temper conditions for the pointed classes is the best thus far obtained, and the flat cylinder and blunt tri-faced leaves little to wish for. There appears to ground for belief that the superior toughness of the thicker points indicates tha methods and degrees of hardness used may prove favorable in larger masses.

Photographs B and B_2 represent the target, a regular structure having been bu which permitted revolution about a pivot.

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*This is possibly due in the work here to its slight excess in weight.

aph C is of the impacts of the rounds below 15° with Class D, showing the .. each projectile and the angle at which fired. None of these broke upon

ctfully, &c.,

W. M. FOLGER,
Lieutenant-Commander, Inspector of Ordnance.

NTGOMERY SICARD,
Chief of Bureau of Ordnance.

MENTS WITH HIGH-POWER MUSKET AND STEEL BULLETS FIRED AGAINST PLATES FROM NEW CRUISERS.

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

e of powder: 202.2 grains.

ered in water at 150° F.; drawn to point yellow-purple; cylinder blue; quenched in water at 100° F.]

les:

	Grains.
s A.—Ogival	379
ss B.—Sharp tri-faced	385
ss C.—Blunt tri faced	406
ss D.—Flat headed cylinder	431
s E.—Studded cylinder	428
s F.—Flat truncated cone	440
G.—Cupped truncated cone	442
H.—Cupped cylinder	430

[Diameter of band of all projectiles, .515 inches.]

ng angles of points:
ass A, 41° 15′.
ass B (face), 38°, (edge) 48°.
ass C, 50° 30′, (edge) 62°.

ing inconvenient to record velocities with an inclined target, only a limited r were observed with each class of pointed projectiles.

s A (mean of 9 shots), striking velocity, 1,958 f. s.; striking energy, 1.43 foot-

s B (mean of 10 shots), striking velocity, 1,940 f. s.; striking energy, 1.43 foot-

s C (mean of 6 shots), striking velocity, 1,924 f. s.; striking energy, 1.488 foot-

Projectiles with pointed heads.

ANGLE OF PLATE, 90 DEGREES; THICKNESS, .5 INCH.

Projectile.		Plate.		Penetration and remarks.
No.	Class.	Thickness.	Angle.	
		Inch.	*Degrees.*	
40	A	.5	90	Pierced plate. Scored left wooden brace; indented hood at rear ½ inch. Unbroken.
27	A	.5	90	Pierced plate. Indented hood .05 inch. Unbroken.
18	B	.5	90	Pierced plate. Struck hood longitudinally and broke up.
16	B	.5	90	Pierced plate. Penetrated .4 inch into standard.
52	C	.5	90	Pierced plate, tumbling on rear standard plate. Broke up.
55	C	5	90	Pierced plate. Penetrated standard .4 inch.

* Best result at each angle.

Projectiles with pointed heads—Continued.

ANGLE OF PLATE, 90 DEGREES; TWO PLATES; THICKNESS, .437 INCH AND

No. of round.	Projectile.		Plate.		Penetration and remarks.
	No.	Class.	Thickness.	Angle.	
			Inch.	*Degrees.*	
7	24	A	.937	90	Pierced outer plate. Projectile remained unbroken, base projecting .08 inch. Pe .8 inch.
8	37	A	.937	90	Pierced outer plate. Bulge, .08 inch; bulle unbroken; base projecting .1 inch. Pe .82 inch.
9	4	B	.937	90	Pierced outer plate. Bulge, ¼ inch. Ba jectile nearly flush with plate. Bullet in broken. Penetration, .9 inch.
10	11	B	937	90	Lost; bands too small; tumbled.
11	49	C	.937	90	Pierced outer plate. Bulge, .15 inch. Ba ing .15 inch. Penetration, .8 inch.
12	53	C	.937	90	Result nearly identical with and equaling Penetration, .9 inch.

ANGLE OF PLATE, 90 DEGREES; THICKNESS, .75 INCH.

No. of round.	No.	Class.	Thickness.	Angle.	Penetration and remarks.
13	23	A	.75	90	Penetrated to flush base. Point projecting rear of plate.
14	32	A	.75	90	Penetrated to within .2 inch of base. inch
15	13	B	.75	90	Wobbled. Penetrated .7 inch and rebound .25 inch.
16	9	B	.75	90	Wobbled. Penetrated .7 inch and rebound .25 inch. Projectile recovered.
17	19	B	.75	90	Penetrated to flush base. Point projecti in rear of plate. Slight improvement on
*18	15	B	.75	90	Base, .2 inch inside. Point projecting ¼ in
19	2	B	.75	90	Base slightly inside. Point projecting .25 i of plate.
20	26	A	.75	90	Results identical with round 17.
21	56	C	.75	90	Base slightly inside. Point projecting . rear of plate.
22	58	C	.75	90	Wobbled. Projectile broke; temper crack.

* Best result at each angle.

ANGLE OF PLATE, 90 DEGREES; THICKNESS, 1 INCH.

No. of round.	No.	Class.	Thickness.	Angle.	Penetration and remarks.
23	34	A	1	90	Penetrated .8 inch; rebounded. Bulge, .1
24	29	A	1	90	Penetrated .8 inch and rebounded. Bulge,
25	5	B	1	90	Penetrated 1 inch. Remained in target. inch.
*26	8	B	1	90	Penetrated 1.05 inches. Remained in targ 25 inch
27	42	C	1	90	Penetrated .8 inch and rebounded. Bulge,
28	51	C	1	90	Penetrated .9 inch. Remained in target. inch.

* Best result at each angle.

ANGLE OF PLATE, 90 DEGREES; THICKNESS (TWO PLATE), .437 AND .5 I

No. of round.	No.	Class.	Thickness.	Angle.	Penetration and remarks.
29	30	A	.937	90	Pierced outer plate. Bulge, .3 inches. Pe 1.2 inch. Base, .05 inch inside.
30	7	B	.937	90	Results identical with round 29.
*31	12	B	.937	90	Results slightly greater than in round 30. tion, 1.2 inches.
32	48	C	.937	90	Results identical with last round, No. 31.

* Best result at each angle.

ANGLE OF PLATE, 50 DEGREES; THICKNESS, .437 INCH.

No. of round.	No.	Class.	Thickness.	Angle.	Penetration and remarks.
33	21	A	.437	50	Pierced plate, turning slightly to left. (temper crack).
34	17	B	.437	50	Pierced plate; direct impact.
35	46	C	.437	50	Pierced plate; turning slightly to left, buri left brace.

Projectiles with pointed heads—Continued.

ANGLE OF PLATE, 40 DEGREES; THICKNESS, .437 INCH.

Projectile.		Plate.		Penetration and remarks.
No.	Class.	Thickness.	Angle.	
		Inch.	*Degrees.*	
28	A	.437	40	Struck screen and then plate at probably smaller angle than 40 degrees. Impact 1 inch long; scored out.
38	A	.437	40	Scored out. Impact .3 inch deep, 1.5 inches long. Bulge, .3 inch.
4	B	.437	40	Score .3 inch deep, 1.5 inches long; effect about equal to round 37.
1	B	.437	40	Results identical with round 37.
60	C	.437	40	Scored out. Impact .25 inch deep.
41	C	.437	40	Results identical with round 40.

* Best result at each angle.

ANGLE OF PLATE, 45 DEGREES; THICKNESS, .437 INCH.

33	A	.437	45	Impact .4 inch deep. Scored out and broke up.
35	A	.437	45	Struck edge of plate. Lost.
39	A	.437	45	Pierced plate; broke up in left brace.
3	B	.437	45	Lost.
20	B	.437	45	Point through .2 inch. Projectile broke up.
10	B	.437	45	Point through. Projectile broken.
8	B	.437	45	Second fire. Pierced plate direct and into brace.

* Best result at each angle.

Projectiles with other than pointed heads.

ANGLE OF PLATE, 40 DEGREES; THICKNESS, .5 INCH.

61	D	.5	40	Bit well. Indent, .45 deep. Bulge, .25 inch.
62	D	.5	40	Bit well. Indent, .47 inch. Bulge, .3 inch.
80	E	.5	40	Projectile started in well. At a penetration of .1 inch stud broke and projectile turned out. Bulge, .25 inch.
87	E	.5	40	Results identical with round 51.
108	F	.5	40	Did not bite. Score 1.5 inches long, .3 inch deep.
116	F	.5	40	Result identical with round 53.
127	G	.5	40	An improvement in the bite, but scored out. Indent, .45 inch. Bulge, .3 inch.
126	G	.5	40	Bit fairly well, but with a tendency to score out. Indent, .45 inch. Bulge, .45 inch.

* Best result at each angle.

ANGLE OF PLATE, 35 DEGREES; THICKNESS, .5 INCH.

76	D	.5	35	Bit well. Indent, .4 inch. Bulge, .3 inch.
65	D	.5	35	Bit very well. Indent, .45 inch. Bulge, .3 inch.
83	E	.5	35	Effects identical with round 51 at 40 degrees.
112	F	.5	35	Scored out. Indent, 3 inch deep.
119	F	.5	35	Lost. Struck edge of target.
136	G	.5	35	Bit fairly well, but turned upward. Cracked plate slightly at rear. Indent, .35 inch.
122	G	.5	35	Scored out turning upward. Indent, .3 inch.
129	G	.5	35	Bit fairly well, but turned downward. Indent, .3 inch. Bulge, .3 inch.

* Best result at each angle.

Projectiles with other than pointed heads—Continued.

ANGLE OF PLATE, 30 DEGREES; THICKNESS, .5 INCH.

No. of round.	Projectile.		Plate.		Penetration and remarks.
	No.	Class.	Thickness.	Angle.	
			Inch.	*Degrees.*	
65	78	D	.5	30	Bit well. Indent, .4 inch. Bulge, .3 inch.
*66	67	D	.5	30	Bit well. Indent, .43 inch. Bulge, .35 inch.
67	125	G	.5	30	Scored out. Indent, .25 inch. Bulge, .2 inch. S turned upward.
68	122	G	.5	30	Bit slightly, but scored out. Indent, .3 inch. Bu .15 inch. Score turned downward.

* Best result at each angle.

ANGLE OF PLATE, 25 DEGREES; THICKNESS, .5 INCH.

*69	68	D	.5	25	Bit well. Indent, .35 inch. Bulge, .3 inch.
70	73	D	.5	25	Scored out (edge broke off). Score, .3 inch deep. B .25 inch.
71	133	G	.5	25	Scored out. Indent, .3 inch. Score turned down (*Vide* remarks inspectors' report.)
72	140	G	.5	25	A shallow score only 1 inch deep. Turned ward.

* Best result at each angle.

ANGLE OF PLATE, 20 DEGREES; THICKNESS, .5 INCH.

73	64	D	.5	20	Bit at first, then scored out (edge broke off).
74	74	D	.5	20	Bit well. Indent, .4 inch. Bulge, .3 inch.
*75	77	D	.5	20	Bit very well. Indent, .45 inch. Bulge, .35 inch
76	88	H	.5	20	Scored out. Indent, .2 inch.
77	97	H	.5	20	Scored out. Indent, .25 inch. Bulge, .1 inch.

* Best result at each angle.

ANGLE OF PLATE, 15 DEGREES; THICKNESS, .5 INCH.

78	94	H	.5	15	Scored out. Indent, .2 inch.
79	70	D	.5	15	Bit very well. Indent, .45 inch deep, 1.5 inches Bulge, .35 inch.
80	72	D	.5	15	Bit well; started to score out (subsequently that a small portion of edge had torn off).

ANGLE OF PLATE, 14 DEGREES; THICKNESS, .5 INCH.

81	75	D	.5	14	Bit well at first, then scored out. Indent, deep, 1.5 inches long. Bulge, .2 inch.
82	66	D	.5	14	Bit very well. Indent, .4 inch deep, 1.5 i Bulge, .3 inch.

ANGLE OF PLATE, 13 DEGREES 30 MINUTES; THICKNESS, .5 INCH.

83	80	D	.5	13.30	Bit well; at end of impact projectile began t scored out. Indent, .35 inch. Bulge, .3 inc
84	71	D	.5	13.30	Bit very well. Indent identical with roun degrees.

ANGLE OF PLATE, 12 DEGREES 30 MINUTES; THICKNESS, .5 INCH.

85	63	D	.5	12.30	Bit very well. Indent equal to rounds 81 an

Projectiles with other than pointed heads—Continued.

ANGLE OF PLATE, 11 DEGREES; THICKNESS, .5 INCH.

Projectile. No.	Projectile. Class.	Plate. Thickness.	Plate. Angle.	Penetration and remarks.
		Inch.	*Degrees.*	
69	D	.5	11	Bit very well. Indent, .35 inch deep, 1.75 inches long. Bulge, .2 inch.

ANGLE OF PLATE, 10 DEGREES 30 MINUTES; THICKNESS, .5 INCH.

79	D	.5	10.30	Bit well at start and turned out.

Compound plate; direct fire.

ANGLE OF PLATE, 90 DEGREES; THICKNESS, .5 INCH.

45	C	.5	90	Indent, .75 inch diameter, .15 inch deep. Circular crack.
43	C	.5	90	Indent, .8 inch diameter, .25 inch deep. Circular crack.
54	C	.5	90	Indent, .75 inch diameter, .25 inch deep. Radial cracks.
36	A	.5	90	Indent, .5 inch diameter, .05 inch deep. Circular cracks.
22	A	.5	90	Indent, .7 inch diameter, .05 inch deep. Circular crack.

* Best result at each angle.

HIGH EXPLOSIVES.

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

have the honor to submit the following summary of the results of the exper- ith high explosives, the details of which, with photographs, have already warded as the work proceeded, in the form of progress notes, made at the luring the months of June, July, and August of this year, in compliance with er of instructions dated May 28, 1884.

der of experiments was as follows:

he explosion, at rest, of shells charged with dynamite and with wet gun-cotton.

e determination of the effect upon the character of the explosion (in regard rection imparted to the explosive wave) of the position of the igniter.

explosion of unconfined charges of dynamite in close proximity, and in ith, a target representing a portion of the side of an armored vessel.

he explosion of unconfined charges of wet gun-cotton upon a target repre- portion of the protected deck of a vessel of war.

he firing of unfuzed shells charged with wet gun-cotton and with dynamite naval 12-pounder S. B. howitzer.

he firing of unfuzed shells charged with wet gun-cotton from the naval 80- B. L. R.

he explosion, by impact, against an armored target, of 80-pounder shells with wet gun-cotton.

THE EXPERIMENTS.

he explosion, at rest, of shells.

were exploded in all thirty-six projectiles, of which—

inch (spherical) were charged with 1 pound of dynamite and ignited by the ne-fuze. The average number of fragments was 168.

inch (spherical) were charged with 12 ounces of wet gun-cotton, and ignited s of the time-fuze and one-half ounce of rifle powder as priming. The aver- ber of fragments was 321.

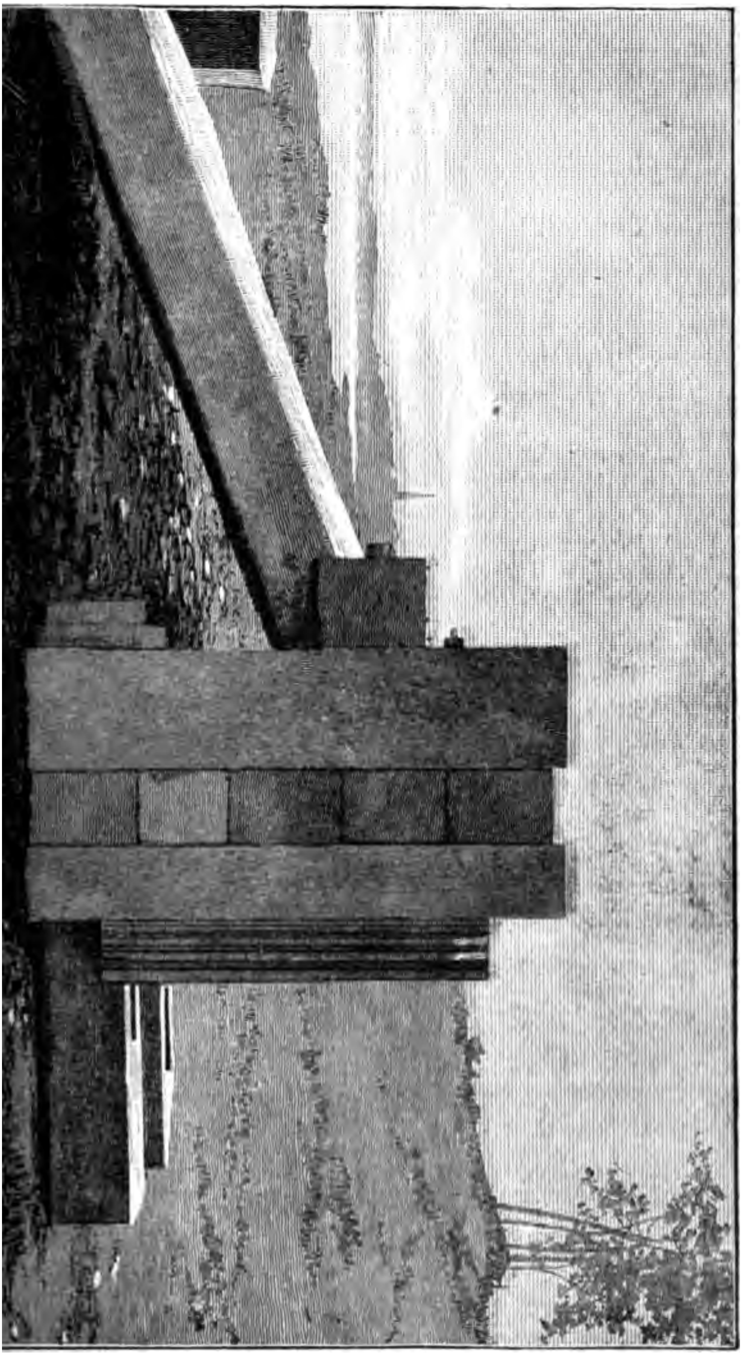
cotton and fulminate igniter, the number of fragments varying f... is believed that the imperfect action in these cases was due to a ... in the density of the charges, it being difficult to secure an inva... compactness with the method pursued of inserting and ramming by the fuze-hole.

With the exception noted, the explosions were complete, as ind... formity in size and by the number of the fragments.

2d. The effect in results of the position of the igniter.

The indications of the progressive action of the explosion wave of the bursting charges of elongated shell being somewhat novel, cl... were suspended in contact with an upright unbacked 1-inch plat... and exploded by means of a mercuric fulminate igniter (40 grains) ... charge or farthest from the plate, and again between the plate a... the first case, using a charge of 10 pounds, directing the explosiv... plate, a hole was made of an area of 192 square inches. In th... action of the igniter being *from* the plate, the hole was but one-... the edges of the fracture indicated considerably less violent action...

It will, however, appear evident (from the cases of incomplete ... charges of shells), that while the point of ignition nearest the tar... found to be the least effective, there is a limit to the destructive ac... *from the plate* due to *cushioning*. Clearly, the most decided result ... a number of powerful igniters so arranged that the distance of m... not be exceeded between any two.



Two hundred and sixty-five pounds of dynamite were exploded in close proximity and in contact with this target in ten successive charges, varying in weight from 5 pounds to 75 pounds.

The injury done the target was hardly noticeable after 70 pounds had been exploded at the same point in six successive charges, and was limited to an inappreciable indentation of the plating, the rupture of one bolt at a defective weld, and a slight springing back of the structure.

With the 50-pound charge the indent was deepened to 3 inches with a diameter of 2 feet 6 inches. Five bolts were broken, and the plates bending forward were slightly separated at the edges.

With the charge of 75 pounds (in contact, as were all charges above 20 pounds), the indent was deepened to 7¼ inches, including the spring outward of plate edges, with a diameter of 3 feet. Four bolts retained fair holding power. The structure had sprung back 2 inches, and had recovered itself in the elastic earth. The middle upright of the backing was somewhat shattered. The outer plate was cracked a distance of 2 feet at the indent in the lines of the perforations.

While the target was considered as not having sustained vital injury, its weak construction, in particular as regards bolting, was apparent, and its condition unsuitable for the prosecution of the experiments with still heavier charges. The plating was therefore removed, the injured backing timber replaced, and the bracing strengthened by a second series of support.

As plating, eleven ⅞-inch sheets, which, having been manufactured for the sides of an armored vessel, possessed a slight crown, were secured to the backing, using fourteen 1.5-inch bolts of wrought iron. The plates were likewise somewhat weakened by old bolt holes, though less than those of the previous target. The completed structure, however, though still deficient in strength, represented more nearly the conditions sought for.

A charge of 100 pounds of dynamite, suspended as in all previous cases of contact so that its weight assisted the bearing pressure, and with outside ignition—85 grains of fulminate in two primers—was exploded against the target with the following results:

Depth of indent, 2¼ inches; diameter, 2 feet. The edges of the plates at the ends were sprung forward about 2 inches, stripping the beveled bolt-heads through the outer plate. The backing structure had sprung back about 2 inches, and had recovered itself. None of the plates were cracked.

In all of the previous experiments the bed logs and earth in front of the target were shattered and torn, a hole in the latter of a depth of perhaps 3 feet being made at the explosion of the charge of 100 pounds. It being apparent that the angle between the ship's side and the water surface offered conditions favorable to the development of more violent action of the gases, a structure representing at water surface—a 1-inch plate upon logs—was built up to the level of the center of the target, and a charge of 75 pounds was pressed firmly into the angle, and exploded, again using two primers containing 85 grains of fulminate.

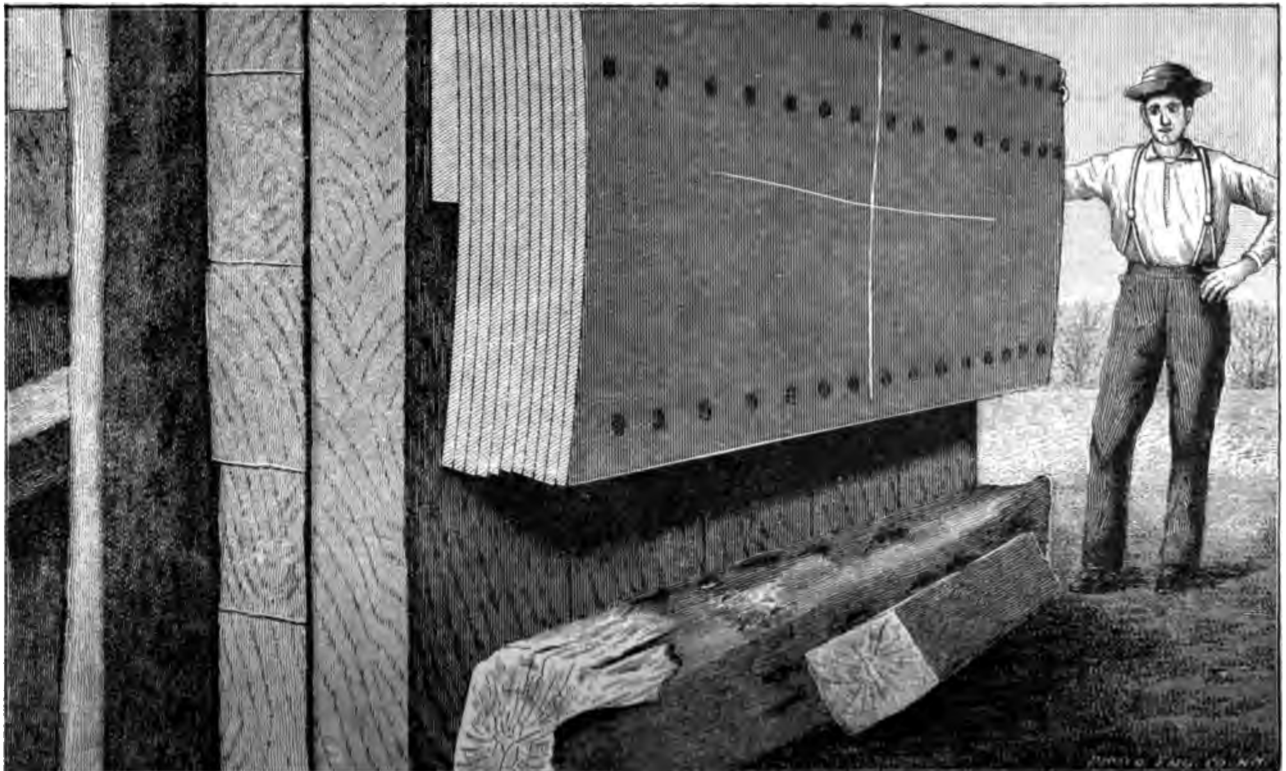
The effects of this charge were notably more decided than those of the preceding one of greater weight, the indent being deepened to 3¼ inches, and the backing and bracing considerably racked and strained. The injuries, however, could not be considered as vital, and the target was left standing without repairs of any description for further experiments. The water-surface structure was, of course, demolished, the iron plate being blown to fragments and the logs almost pulverized.

The effects produced by the explosion of these large charges are decidedly less striking than those reported elsewhere, notably in Russia and France, and it is believed that the difference may be accounted for by the absence in the foreign experiments of special preparation in the way of bolting for the target plates. Usually the latter have been placed upon the ground, the corners and edges free of all restraint, except their inertia, to move *upward* at the shock of discharge. It seems clear that the energy of the explosive wave will be concentrated upon the target under vastly more favorable conditions (in which the "tamping" of the charge through its own weight will play but slight part), in such an arrangement, than with those presented by the wall of a steel-clad vessel of war. The latter presents the most resistant qualities to the explosive wave of dynamite (which differs in nowise from that of other explosives in its impulse toward least resistance), having great hardness, inertia, and tensile strength, of which last the bolting forms perhaps the more important portion.

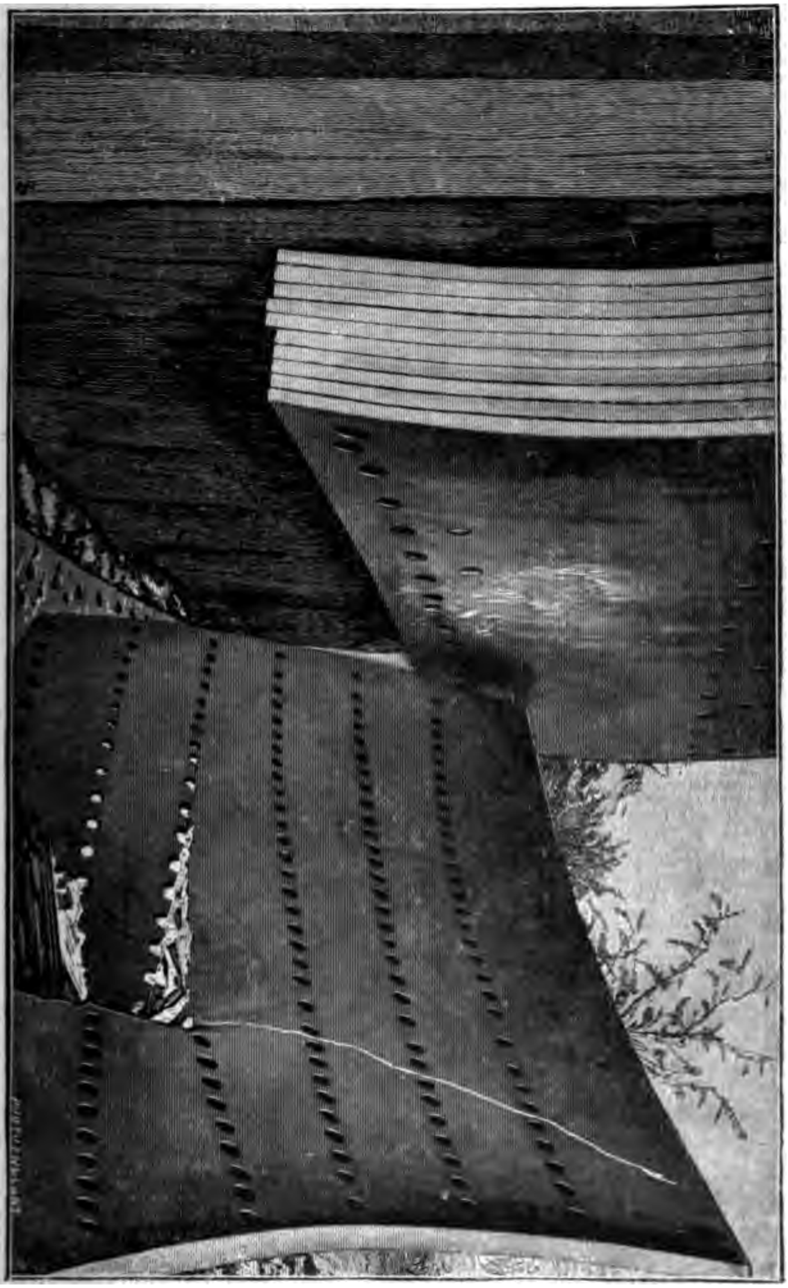
Again, although in the final experiments the quality of fulminate was doubled, and in amount equal to more than ten times that considered sufficient to "detonate" dynamite, the effects may be considered as modified by the weight of the charges used, it being here apparent, as previously noted, and as referred to in the German results, that these—the effects—do not increase beyond a certain point with the weight of the charge, the *ignition surface remaining constant.*

The conclusion to be drawn from the results obtained is, that a modern armor-clad will not receive material injury by the explosion in superficial contact with iron over water plating of very large charges of dynamite.

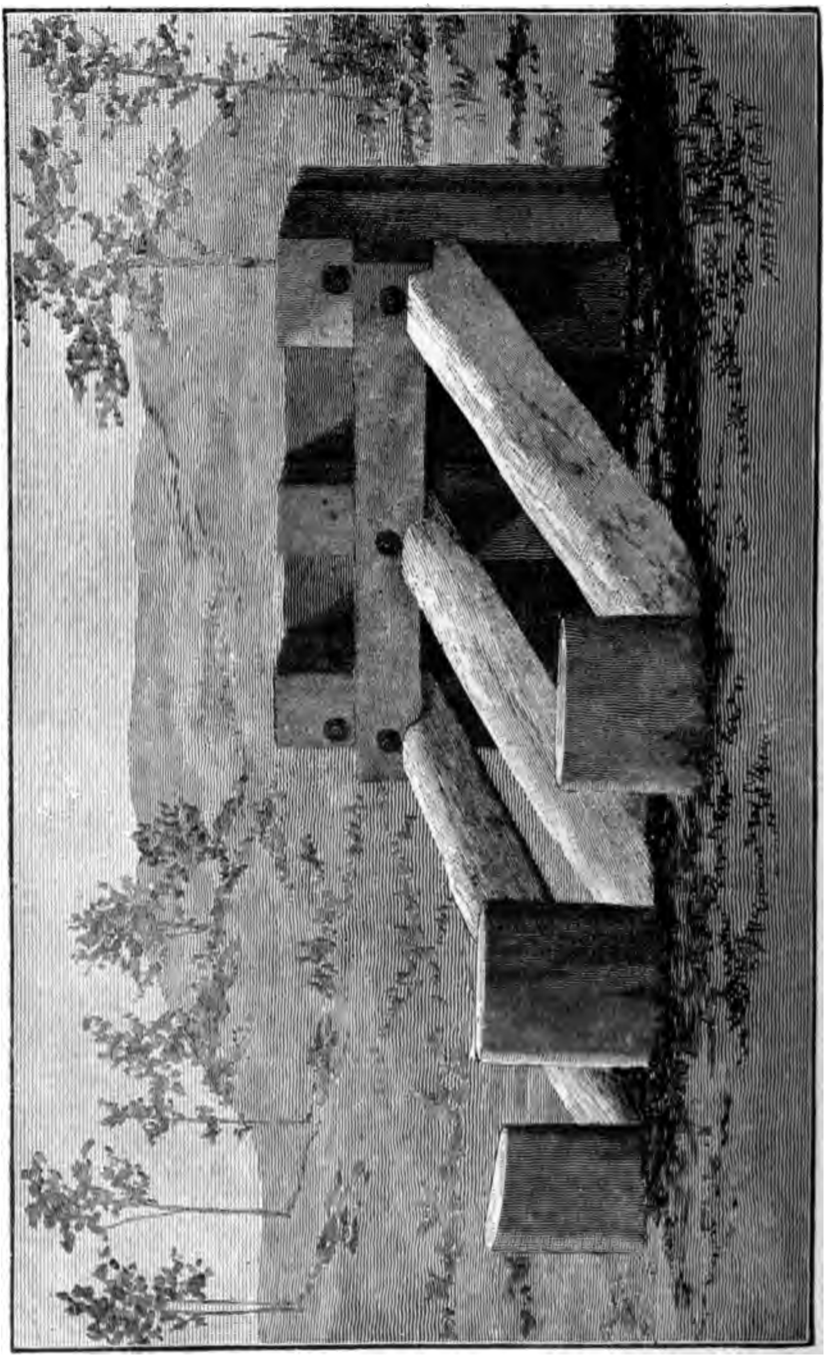
[illegible] pounds of dynamite as prepared for explosion against face of target.



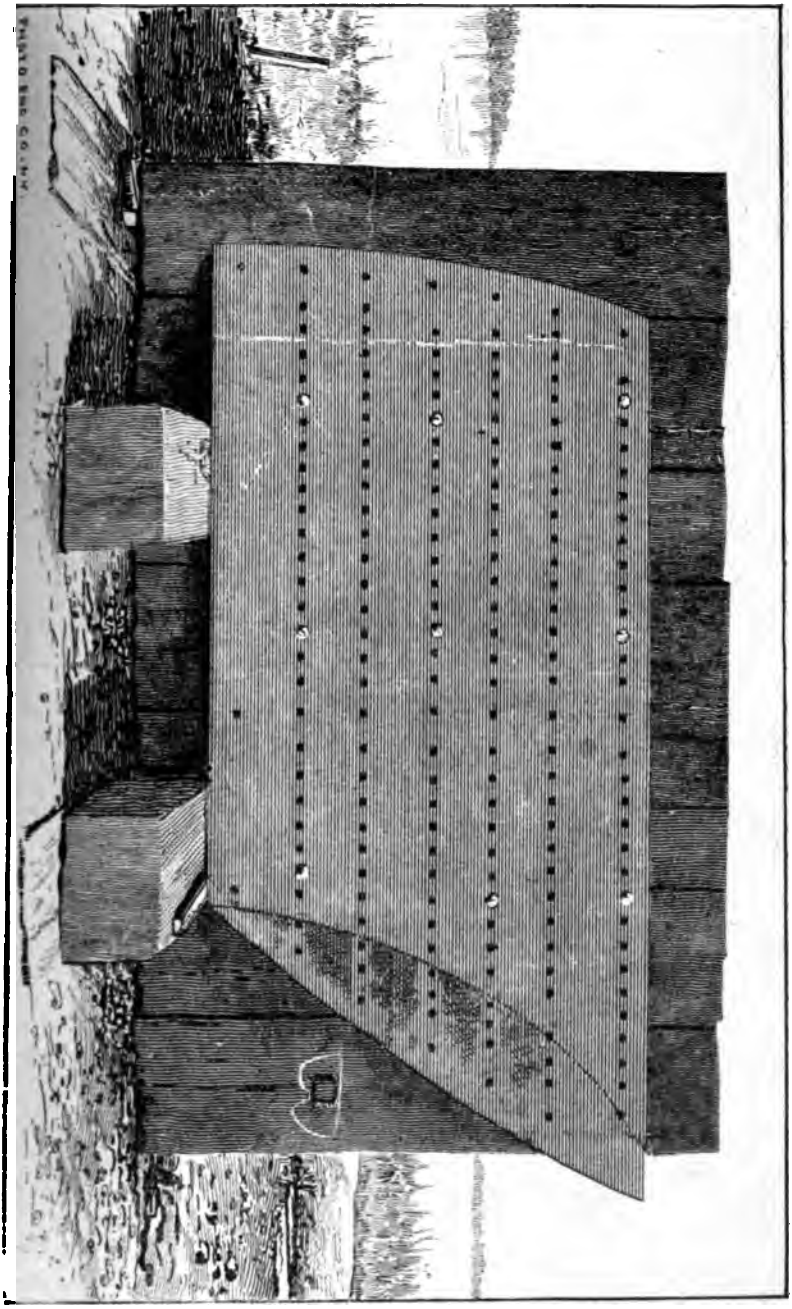
B.—Face of target after explosion of 100



D.—Showing effect of 75 pounds dynamite upon target arranged (see C) to represent water-line.

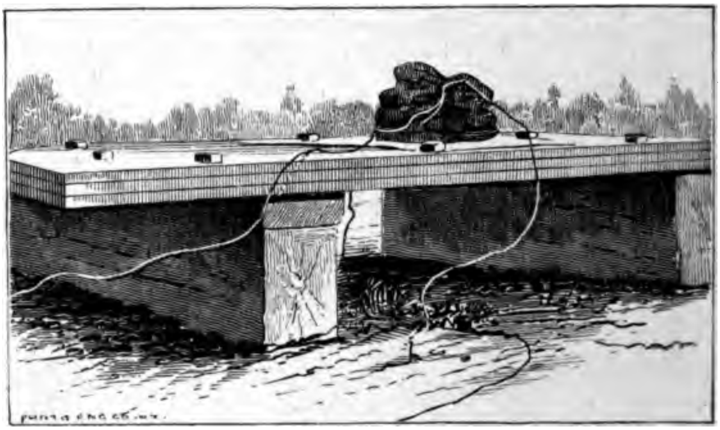


Rear view of target.



4th. The explosion of charges of wet gun-cotton upon an armored deck.

In constructing the target for this experiment, an endeavor was made to represent the strength of 2 inches of steel suitably supported.

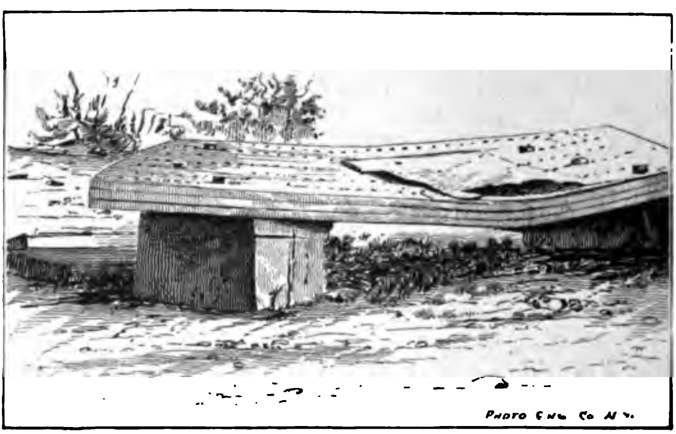


A.—Plates representing protected ship's deck with 25 pounds gun-cotton ready for explosion.

Three perforated wrought-iron plates, similar to those already described in the dynamite experiments, were joined firmly together, using eight 1-inch bolts. The three-fold plate thus formed was bolted to heavy timbers distant from each other about 4½ feet. Two 1-inch bolts were placed at each end, passing nearly through the timber. To eliminate, as far as might be, the effects of the perforations, sheets of ½-inch iron were inserted on each side of the middle plate, while a third was placed upon the target to receive the charge. There was thus a total strength (nearly) of 3½ inches of iron.

A suitable number of experiments having first been made apart to determine the most effective weight of dry cotton for the primer for this charge, 25 pounds of wet gun-cotton were exploded upon the target, using as an ignition (placed above) 20 ounces of dry cotton with 85 grains of mercurial fulminate.

A hole, 7 by 8 inches, about one-half the area of the base of the charge, was blown through all plates with the effects of the explosion reaching a depth of about 18 inches in the rather friable earth beneath. The bend of the plates extended to the timbers, without starting the bolts, with a depth of about 7½ inches.



B.—Showing effect of 25 pounds gun cotton exploded upon plates representing protected ship's deck.

An interesting evidence of the direction given by the explosion is shown in the imprints made by the basis of the cotton disks, not merely in the $\frac{1}{2}$-inch plate, but in the 1-inch plate underneath.

C.—View looking down upon plates after explosion of 25 pounds gun-cotton, showing impress of discs produced by downward progress of explosive ware (igniter having been placed on top.)

5th. The firing of unfuzed shells charged with wet gun-cotton and with dynamite from the 12-pounder howitzer.

A. Wet gun-cotton charges.

Twelve preliminary rounds were fired, using a less violent powder than is employed in service with this gun, together with a gradual diminution of air space and waste cushion in the base of the shell and an increase of weight of bursting charge.

Ten rounds were then fired down the bay, using service charges of powder, full bursting charges (5 ounces), with neither air space nor waste cushion. There was no case of premature explosion.

B. Dynamite charges.

The experiment with dynamite bursting charges with this gun was precisely similar as regards preliminary rounds and precautionary measures as in the previous experiment with gun-cotton charges. Ten rounds with service conditions, the bursting charge being about $5\frac{1}{4}$ ounces, were also fired. There was likewise no case of explosion by the shock of the discharge. A single shell exploded upon impact with the water.

6th. The firing of unfuzed shells charged with wet gun-cotton from the 80-pounder B. L. R.

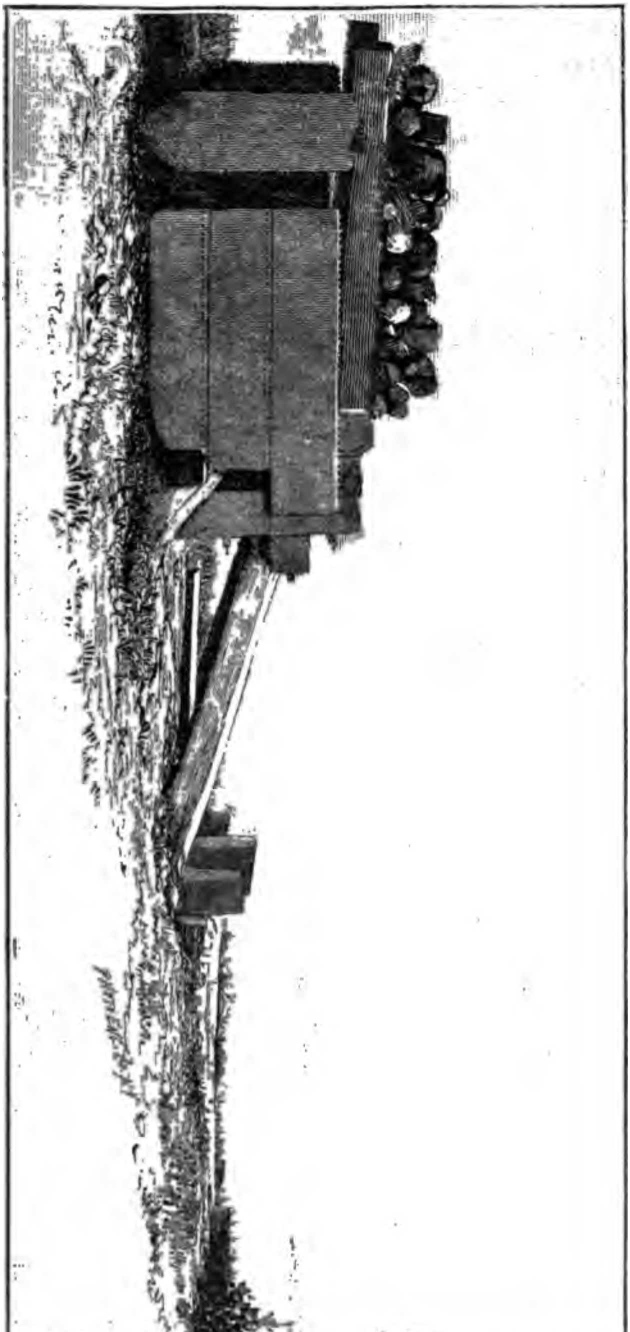
Having fired five preliminary rounds with reduced charges and bursting charges, 10 rounds were fired down the bay, using filled shell, about 3 pounds, with service charges of powder, 10 pounds. The only precaution taken to relieve the shock of discharge was the placing of a layer of oakum $\frac{1}{2}$ inch in thickness in the bottom of the shell. There was no case of premature explosion.

7th. The explosion by impact against an armored target of shells charged with wet gun-cotton.

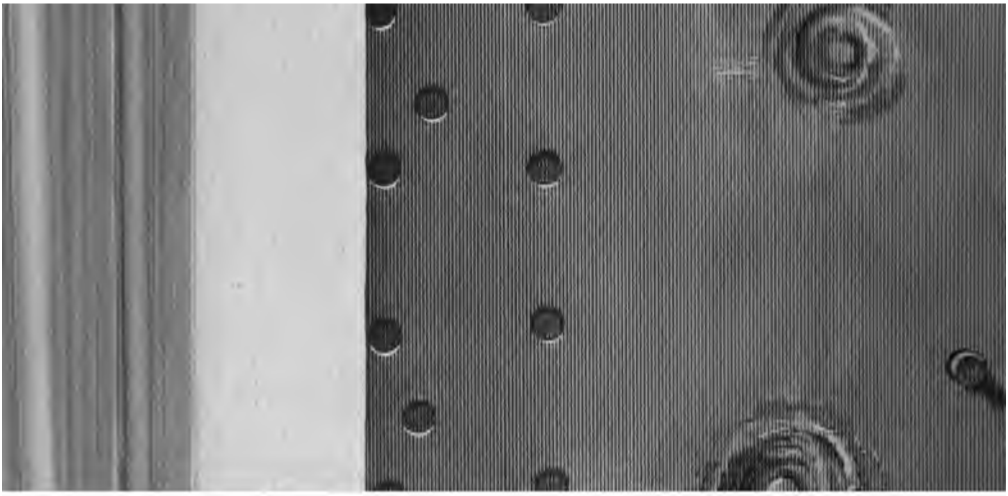
The piece used and the conditions and weight of charges were those of the previous experiment.

The target plating was that which had served for the superficial explosion of 175 pounds of dynamite, referred to in No. 3 of this report. The target structure, it will be remembered, had withstood the shocks of 440 pounds of dynamite in twelve successive charges.

The projectile was the service common shell (80 pounds) of cast-iron.



B.—Side view of target and shelter.



gun was distant from the target about 50 yards.
striking velocity was about 1,250 f. s.
rounds were fired, all of which exploded upon impact, furnishing nearly iden-
sults with each other. The depth of the impact was about 2 inches, with a
r of 10 inches. No plates were ruptured.
vidence of the explosion at impact, besides the separated reports plainly ap-
n two of the three rounds, was at hand in the extremely small size of the frag-
the projectiles, and in the fan-like spread of the effects upon the interior
a shelter which, as a measure of safety, had been placed around the target.
re were the fragments projected rearwards more than 10 inches or 12 inches,
ead out in a flat circle about the impact.
get structure, backing and supports was in no wise injured.
clusions which may be drawn from the experiment are—
g a weak shell charged with the high explosives, no material injury would
the over-water defense of a modern armor-clad, even with gunpowder as the
re force, and using greatly increased bursting charges. The effects *nil* with
ies will be equally valueless with high velocities.
believed that, using a strong walled *steel* projectile, the explosion occurring
at an elevation of temperature of less than 300° F., the effects will be less
n with similar projectiles charged with gunpowder.
sir, very respectfully,

W. M. FOLGER,
Lieutenant-Commander, Inspector of Ordnance,
In charge Naval Ordnance Proving Ground.

NTGOMERY SICARD,
Chief of Bureau of Ordnance.

NAVAL ORDNANCE PROVING GROUND,
Annapolis, Md.

With the view of utilizing the results furnished by the high-explosive exper-
made at this station in compliance with your instructions during the past year,
icular the important fact that it is proved to be possible to obtain an explosive
ion of wet gun-cotton, I have the honor to submit for your consideration a
the development of a rifled torpedo mortar which shall carry a large bursting
of wet gun-cotton.
xperiments of Frederick Krupp, in 1881-'82, have demonstrated the feasibility
rting suitable rotation to a projectile of the length proposed, and were also
remarkable for the extraordinary accuracy of fire obtained.
experiments in May and June of this year at this station in the direction of
ping the destructive effects of the explosion of a charge of gun cotton upon the
ted deck of a vessel of war, indicate the importance of utilizing, if possible,
wer of the high explosives.
eing also proven to be entirely practicable to use gunpowder as the propulsive
, there seems to be reasonable grounds for believing that an arm of the character
sed is susceptible of successful development, and its value in a military direc-
annot be seriously questioned.
order to proceed with due regard to the economical side of the question I have
nor to suggest:
That five cast-iron torpedoes of the dimensions of sketch A (unbanded and
ut longitudinal ribs) be manufactured, with which it is proposed to develop the
practicable means for obtaining a complete combustion of the charge, proceed-
the plan described in the experiments of May last with gunpowder priming.
s expected that a distribution of the priming charge (which may be found to be
ably another material than simple black gunpowder) throughout the mass of
at gun cotton will effect that simultaneous rise in pressure in all parts of the
which should produce the desired result.
This preliminary experiment furnishing results corroborating previous work,
then proposed to convert one of the service XI-inch S. B. guns into an 11-inch
rifled mortar (sketch B), carrying a projectile of cast steel of a (charged) weight
pounds.
trunnion band to be of steel or wrought-iron, as the Bureau shall approve, the
nnions being removed.
projectile has a length of four calibres. It is strengthened for base strains by
ting shown in the sketch. The (Butler) band is given an excessive length in
to increase the grip.
bursting charge is 85 pounds of wet gun-cotton. The rifling, uniform, of a
of one turn in 15 calibres, is 30 grooves and lands of a depth of the former of
. The charge of powder will be in the neighborhood of 15 pounds, to be estab-
d experimentally.

Should a successful trial follow your approval of the design proposed, the further development of the arm to a calibre of 12 inches, the piece being of steel and breech-loading, will be submitted for your consideration.

The details of such an arm, subject to modifications found necessary in the experiments with the converted gun, are now being prepared, and will be forwarded for your inspection upon completion.

Respectfully, &c.,

W. M. FOLGER,
Lieutenant-Commander, Inspector of Ordnance.

Capt. MONTGOMERY SICARD,
Chief of Bureau of Ordnance.

GUN-TORPEDOES. 278/1884

SIR: With a view to securing a combination of the destructiveness of a subaqueous explosion with the accuracy to be attained in a trajectory through the air, I would respectfully suggest the following design for a "gun-torpedo":

The "gun-torpedo" is designed to be a shell filled with wet gun-cotton and fitted with a large gunpowder fuze, and covered with lead or other inelastic substance. It is intended to be fired against the side of a ship, but not to penetrate it; the function of the lead covering being to deaden the shock of impact, thus preventing the breaking of the shell or its rebounding to a great distance. After impact the "gun-torpedo" will drop into the water, sink and explode below the surface, and near the under water body of the ship, the action of the fuze being delayed.

The gun-torpedo may be elongated or spherical. For experiment I would propose the simplest form, *i. e.*, a spherical shell fitted with a time-fuze, the fuze being cut to about two seconds longer than the time of flight.

I would respectfully call the attention of the Bureau to the fact that, by reason of the cheapness of these torpedoes, a great number could be fired simultaneously at small expense. A torpedo-boat could carry, say, six in broadside. When the torpedo-boat passes an enemy's ship, say, at a distance of 300 yards, the man at the wheel can discharge the 6 gun-torpedoes by pressing an electric key. It seems reasonable to suppose that these six torpedoes, each filled with 30 pounds of gun-cotton, would have a much better chance of injuring the ship than one comparatively slow moving Whitehead. It seems reasonable also to hope that ships could be similarly equipped and much greater ranges eventually obtained. It is clear that nets and other under-water obstructions would offer no protection against such a torpedo.

I have the honor to be, very respectfully,

B. A. FISKE,
Lieutenant, United States Navy.

Capt. MONTGOMERY SICARD, U. S. N.,
Chief of Bureau of Ordnance.

ANNUAL REPORT, 1883 *AND* 1884.

231/1884 UNITED STATES TORPEDO STATION,
Newport, R. I.

OFFICERS ATTACHED TO STATION, 1884.

Capt. T. O. Selfridge, inspector of ordnance, in charge.

Lieut. Commander T. F. Jewell, assistant inspector of ordnance and instructor in electricity.

Lieut. Commander J. S. Newell, assistant inspector of ordnance and instructor in torpedoes.

Lieut. W. Maynard, assistant inspector of ordnance and assistant instructor in electricity.

Lieut. T. C. McLean, assistant inspector of ordnance and instructor in fuzes.

Prof. J. Fleming White, chemist and instructor in chemistry and explosives.

Paymaster. Stephen Rand.

Surgeon, J. B, Parker.

Gunner, J. R. Grainger.

The following officers reported April 30:

For attendance on the course of instructions.

Capt. Arthur R. Yates.

For instruction.

Lieut. Commanders John McGowan, F. A. Miller, William Welsh; Lieuts. J. C. Morong, G. M. Totten, J. N. Hemphill, E. W. Bridge, J. D. J. Kelley, E. S. Prime, A. P. Nazro, D. D. V. Stuart, L. L. Reamey, Aaron Ward, S. W. B. Diehl, W. Winder, E. McCartney; Second Lieuts. H. K. White and J. E. Mahoney, United States Marine Corps.

The course of instruction embraced the months of May, June, and July.

The attendance of officers for instruction was from the 9.30 a. m. boat to the 2.30 p. m. boat.

The days were divided into two periods: First period, from 9.45 a. m. to 11.45 a. ; second period, from 12.15 p. m. to 2.15 p. m.

The lectures and practical exercises, as per schedule, were posted in the officers' room and on the ferry launch.

The officers under instruction were required to have ready each Monday morning, for the examination of the commanding officer, a careful and neatly written *résumé* of the lectures of the previous week, giving detailed drawings, descriptions, and explanations of such things as were specially designated by the instructors. Blank books were furnished for this purpose. These books were examined by the instructors, all errors noted, and returned to the commanding officer.

As a general rule for practical exercises the class were divided into three parts.

At the close of the course of instruction an examination was held before the Board of Visitors, to whom the books of the officers under instruction were submitted.

The following schedule of lectures and practical exercises was carried out:

Date.	Section or whole class.	Lecture or practical exercise.
Thursday, May 1 (a. m.)	Whole	Electricity: Introductory elementary mechanical principles, &c.
Friday, May 2 (a. m.)	...do	Explosives: Introduction to chemistry and explosives.
Monday, May 5 (a. m.)	...do	Electricity: Frictional conduction and distribution of electricity.
Monday, May 5 (p. m.)	...do	Explosives: Ignition and detonation.
Tuesday, May 6 (a. m.)	...do	Electricity: Magnetism, terrestrial, and diamagnetism.
Tuesday, May 6 (p. m.)	...do	Explosives: Explosive mixtures and explosive compounds.
Wednesday, May 7 (a. m.)	...do	Electricity: Current electricity; simple Voltaic cell; electromotive force; Ohin's law.
Wednesday, May 7 (evening)	One-fourth class	Electricity: Electric lights (practical).
Thursday, May 8 (a. m.)	Whole	Electricity: Current electricity resistance; branch currents; polarization.
Thursday, May 8 (p. m.)	...do	Explosives: Preparation of material for gunpowder.
Friday, May 9 (a. m.)	...do	Electricity: Current electricty; laws relating to currents; Voltaic batteries; thermo-electricity.
Monday, May 12 (a. m.)	...do	Torpedoes: Introduction; gunpowder spar torpedo.
Monday, May 12 (p. m.)	...do	Explosives: Manufacture of gunpowder.
Tuesday, May 13 (a. m.)	...do	Torpedoes: Gunpowder spar torpedo.
Tuesday, May 13 (p. m.)	...do	Electricity: Current electricity; effects produced by current, thermal, and chemical electrolysis.
Wednesday, May 14 (a. m.)	...do	Torpedoes: Gunpowder spar torpedo.
Wednesday, May 14 (evening)	One-fourth class	Electricity: Electric lights (practical).
Thursday, May 15 (a. m.)	Whole	Torpedoes: Gun-cotton service spar torpedo; outfits, &c.
Thursday, May 15 (p. m.)	...do	Electricity: Electro magnetics; effects of currents.
Friday, May 16 (a. m.)	...do	Torpedoes: Gun-cotton service spar torpedo; outfits, &c.
Friday, May 16 (evening)	One-fourth class	Electricity: Electric lights (practical).
Monday, May 19 (a. m.)	Whole	Torpedoes: Gun-cotton service spar torpedo; outfits, &c.
Monday, May 19 (p. m.)	...do	Explosives: Manufacture of gunpowder.
Tuesday, May 20 (a. m.)	...do	Electricity: Electro-magnetics; Ampire's theory; electric magnets.
Tuesday, May 20 (p. m.)	...do	Torpedoes: Electrical apparatus furnished to ships, and improvised torpedoes.
Wednesday, May 21 (a. m.)	...do	Explosives: Properties; testing and firing gunpowder.
Wednesday, May 21 (evening)	One-fourth class	Electricity: Electric lights (practical).
Thursday, May 22 (a. m.)	Whole	Electricity: Electro-magnetics; magneto-electric induction.
Thursday, May 22 (p. m.)	...do	Torpedoes: Electrical apparatus furnished ships, and improvised torpedoes.
Friday, May 23 (a. m.)	...do	Explosives: History and theory of nitro compounds.

Date.	Section or whole class.	Lecture or practical exercise.
Friday, May 23 (evening) ...	One-fourth class ..	Electricity: Electric lights (practical).
Monday, May 26 (a. m.)	Whole	Electricity: Service firing machines; earlier forms; Farmer's A and C machines.
Monday, May 26 (p. m.)	....do	Torpedoes: Circuit-closers, &c.: special torpedo vessels; foreign spar torpedoes, &c.
Tuesday, May 27 (a. m.)	....do	Torpedoes: Firing torpedoes.
Tuesday, May 27 (p. m.)	.. do	Explosives: Nitro-glycerine; preparation of material.
Wednesday, May 28 (a. m.) ..	....do	Torpedoes: Defensive torpedoes; cases; different kinds; mooring; explosives; cables; junction boxes.
Wednesday, May 28 (evening)	One-fourth class ..	Electricity: Electric lights (practical).
Thursday, May 29 (a. m.)	Whole	Electricity: Electrical measurements; galvanometers and resistance coils.
Thursday, May 29 (p. m.)	.. do	Explosives: Nitro-glycerine; theory of manufacture and explosion.
Monday, June 2 (a. m.)	....do	Electricity: Electrical measurements; measurement of resistances.
Monday, June 2 (p. m.)	....do	Torpedoes: Defensive; cut-offs; planting; charging.
Tuesday, June 3 (a. m.)	First section	Setting up batteries (practical).
	Second section	Use of electrical apparatus (practical).
	Third section	Making igniters (practical).
Tuesday, June 3 (p. m.)	First section	Use of electrical apparatus (practical).
	Second section	Making igniters (practical).
	Third section	Setting up batteries (practical).
Wednesday, June 4 (a. m.) ...	Whole	Electricity: Electromotive force; battery resistance; measurements.
Wednesday, June 4 (p. m.) ...	First section	Making igniters (practical).
	Second section ..	Setting up batteries (practical).
	Third section	Use of electrical apparatus (practical).
Wednesday, June 4 (evening).	One-fourth class ..	Electricity: Electric lights (practical).
Thursday, June 5 (a. m.)	Whole	Torpedoes: Defensive; most effectual depths; radius of destructive effect; necessary intervals.
Thursday, June 5 (p. m.)	.. do	Explosives: Nitro-glycerine; manufacture of.
Friday, June 6 (a. m.)	First section	Measurement of resistances (practical).
	Second section ...	Detecting faults (practical).
	Third section	Making igniters (practical).
Friday, June 6 (evening) ...	One-fourth class ..	Electric lights (practical).
Monday, June 9 (a. m.)	Whole	Torpedoes: Determining the position of a vessel in reference to torpedoes; defense of channels; firing by observation; firing-tables.
Monday, June 9 (p. m.)	... do	Explosives: Compounds of nitro-glycerine.
Tuesday, June 10 (a. m.)	... do	Electricity: Fuzes; theory; materials; arrangements of circuits.
Tuesday, June 10 (p. m.)	First section	Detecting faults (practical).
	Second section	Making igniters (practical).
	Third section	Measurement of resistances (practical).
Wednesday, June 11 (a. m.) .	Whole	Torpedoes: Shutter apparatus; single-main system.
Wednesday, June 11 (p. m.) ..	First section	Making igniters (practical).
	Second section	Measurement of resistances (practical).
	Third section	Detecting faults (practical).
Wednesday, June 11 (evening)	One-fourth class ..	Electric lights.
Thursday, June 12 (a. m.) ...	Whole	Torpedoes: Clearing channels; sweeping.
Thursday, June 12 (p. m.)	....do	Electricity: Dynamo-electric machines; principal types.
Friday, June 13 (a. m.)	First section	Measurement of resistances (practical).
	Second section	Boat torpedoes; gunpowder (practical).
	Third section	Making dynamo-electric fuzes (practical).
Friday, June 13 (evening) ..	One-fourth class ..	Electric lights (practical).
Monday, June 16 (a. m.)	Whole	Torpedoes: Clearing channels; dragging.
Monday, June 16 (p. m.)	....do	Electricity: Dynamo-electric machines; principal types.
Tuesday, June 17 (a. m.)	.. do	Explosives: Nitro-glycerine; storage, inspection, transportation, uses, and exploding of.
Tuesday, June 17 (p. m.)	First section	Boat torpedoes; gunpowder (practical).
	Second section	Making dynamo-electric fuzes (practical).
	Third section	Measurement of resistances (practical).
Wednesday, June 18 (a. m.) ..	Whole	Torpedoes: Clearing channels: countermining.
Wednesday, June 18 (p. m.) ..	First section	Making dynamo-electric fuzes (practical).
	Second section	Measurement of resistances (practical).
	Third section	Boat torpedoes; gunpowder (practical).
Wednesday, June 18 (evening)	One-fourth class ..	Electric lights (practical).
Thursday, June 19 (a. m.) ...	Whole	Electricity: Dynamo-electric machines; efficiency, &c.
Thursday, June 19 (p. m.) ...	.. do	Explosives: Gun-cotton; history of; theory; manufacture and preparation of raw material.
Friday, June 20 (a. m.)	First section	Measurement of current, and E. M. F. (practical).
	Second section	Ships' torpedoes; gunpowder (practical).
	Third section	Improvised fuzes and detonators (practical).
Friday, June 20 (evening) ...	One-fourth class ..	Electric lights (practical).
Monday, June 23 (a. m.)	Whole	Torpedoes: Electrically controlled boats.

te.	Section or whole class.	Lecture or practical exercise.
e 23 (p. m.)	Whole	Electricity: Arc lighting.
e 24 (a. m.)	First section	Ships' torpedoes; gunpowder (practical).
	Second section	Improvising fuzes and detonators (practical).
	Third section	Measurements of currents, and E. M. F. (practical).
e 24 (p. m.)	First section	Improvising fuzes and detonators (practical).
	Second section	Measurements of currents, and E. M. F. (practical).
	Third section	Ships' torpedoes; gunpowder (practical).
June 25 (a. m.)	Whole	Explosives: Gun-cotton manufacture at this station.
June 25 (p. m.)	do	Electricity: Incandescent lighting.
une 25 (evening)	One-fourth class	Electric lights (practical).
ne 26 (a. m.)	Whole	Torpedoes: Torpedo-boats.
ne 26 (p. m.)	do	Electricity: Electric transmission of power; motors; search-light apparatus.
. m.)	First section	Measurement of currents, and E. M. F. (practical).
	Second section	Improvised torpedoes (boats) (practical).
	Third section	Ships' torpedoes; gun-cotton (practical).
27 (evening)	One-fourth class	Electric lights (practical).
e 30 (a. m.)	Whole	Explosives: Gun-cotton manufacture at Waltham, Abbey, and Stowmarket.
e 30 (p. m.)	do	Torpedoes: Torpedo-boats.
y 1 (a. m.)	First section	Improvised torpedoes (boats) (practical).
	Second section	Measurements of currents, and E. M. F. (practical).
	Third section	Ships' torpedoes: Gun-cotton (practical).
y 1 (p. m.)	First section	Do.
	Second section	Improvised torpedoes (boats) (practical).
	Third section	Measurements of currents, and E. M. F. (practical).
July 2 (a. m.)	Whole	Electricity: Secondary batteries; theory of charge and discharge; Brush system.
July 2 (p. m.)	do	Torpedoes: Movable; Whitehead.
July 2 (evening)	One-fourth class	Electric lights (practical).
ly 3 (a. m.)	Whole	Explosives: Gun-cotton, testing, storing, inspecting, transporting, and safety of.
ly 3 (p. m.)	do	Electricity: Telephone, bells, induction balance, &c.
7 (a. m.)	do	Explosives: Gun-cotton preparation of ship's supplies, storing, inspecting, and care on shipboard.
7 (p. m.)	do	Torpedoes: Movable torpedoes; Whitehead.
y 8 (a. m.)	do	Explosives: Gun-cotton, exploding and application of.
y 8 (p. m.)	First section	Dynamo machines and arc lamps (practical).
	Second section	Boat gun-cotton torpedoes (practical).
	Third section	Testing and packing gun-cotton (practical).
July 9 (a. m.)	First section	Boat gun-cotton torpedoes (practical).
	Second section	Testing and packing gun-cotton (practical).
	Third section	Dynamo machines and arc lamps (practical).
July 9 (p. m.)	First section	Testing and packing gun-cotton (practical).
	Second section	Dynamo machines and arc lamps (practical).
	Third section	Boat gun cotton torpedoes (practical).
July 9 (evening)	One-fourth class	Electric lights.
ly 10 (a. m.)	Whole	Torpedoes: Movable; Whitehead.
ly 10 (p. m.)	do	Electricity: Supplementary.
11 (a. m)	First section	Measurements of machines E, M, F, and R (practical).
	Second section	Countermining and net defense (practical).
	Third section	Fast launches (practical).
11 (evening)	One-fourth class	Electric lights (practical).
14 (a. m.)	Whole	Torpedoes: Lay (practical).
14 (p. m.)	do	Explosives: Fulminate of mercury, manufacture, storing, transporting and uses of (practical).
y 15 (a. m.)	First section	Countermining and net defense (practical).
	Second section	Fast launches (practical).
	Third section	Measurements of machines, E, M, F, and R (practical).
y 15 (p. m.)	First section	Fast launches (practical).
	Second section	Measurements of machines E, M, F, and R (practical).
	Third section	Countermining and net defense (practical).
uly 16 (a. m.)	Whole class	Torpedoes: Movable; lay (practical).
uly 16 (p. m.)	do	Torpedoes: Drifting torpedoes, submarine, guns and projectiles, rockets, &c. (practical).
uly 16 (evening)	One-fourth class	Electric lights (practical).
ly 17 (a. m.)	First half	Making nitro-glycerine, dynamite, and explosive gelatine (practical).
ly 17 (p. m.)	Second half	Towing torpedoes (practical).
8 (a. m.)	First half	Do.
	Second half	Making nitro-glycerine, dynamite, and explosive gelatine (practical).
8 (p. m.)	Whole class	Submarine diving (practical).
8 (evening)	One-fourth class	Electric light (practical).
y 19 (a. m.)	Whole class	Submarine diving (practical).
21 (a. m.)	do	Torpedoes: Attack with and defense against offensive torpedoes, nets, &c.
21 (p. m.)	do	Explosives: Other explosives and liquid carbonic acid for propelling movable torpedoes.

Date.	Section or whole class.	Lecture or practical exercise.
Tuesday, July 22 (a. m.).....	First half.........	Efficiency of machines and lamps (practical).
	Second half.......	McEvoy's single main system defensive mines (practical).
Tuesday, July 22 (p. m.)......	First half.........	Efficiency of machines and lamps (practical).
	Second half.......	McEvoy's single main system (practical).
Wednesday, July 23 (a. m.) ..	First half.........	Efficiency of machines and lamps (practical).
	Second half.......	McEvoy's single main system (practical).
Wednesday, July 23 (p. m.) ..	First half.......	Efficiency of machines and lamps (practical).
	Second half.......	McEvoy's single main system (practical).
Wednesday, July 23 (evening)	One-fourth class ..	Electric lights (practical).
Thursday, July 24 (a. m.)	First half.........	McEvoy's single main system (practical).
	Second half.......	Efficiency of machines and lamps (practical).
Thursday, July 24 (p. m.)	First half	McEvoy's single main system (practical).
	Second half.......	Efficiency of machines and lamps (practical).
Friday, July 25 (a. m.)........	First half.........	McEvoy's single main system (practical).
	Second half.......	Efficiency of machines and lamps (practical.)
Friday, July 25 (p. m.)........	First half.........	McEvoy's single main systen (practical).
	Second half.......	Efficiency of machines and lamps (practical).
Friday, July 25 (evening)	One-fourth class ..	Electric lights (practical).
Saturday, July 26 (a. m.)	Whole class	Submarine diving (practical).
Monday, July 28 (a. m.)	First half.........	Installation and care of dynamos and electrical cuits, working and care of high-speed engi mounting and dismounting of engines and dyn mos (practical).
	Second half......	English shutter system of defensive mines (pract cal).
Monday, July 28 (p. m.)	First half.........	Installation and care of dynamos, &c. (practical)
	Second half.......	English shutter system (practical).
Tuesday, July 29 (a. m.)......	First half.........	Do.
	Second half.......	Installation and care of dynamos, &c. (practical)
Tuesday, July 29 (p. m.).....	First half.........	English shutter system (practical).
	Second half.......	Installation and care of dynamos, &c. (practical)
Wednesday, July 30 (a. m.)...	Whole class	Run Lay-Haight boat (practical).
Wednesday, July 30 (p. m.) ..	....do	Run electrically, controlled launch (practical).
Wednesday, July 30 (evening)	Half class........	Search lights (practical).
Thursday, July 31 (a. m.)	First half.........	Do.
	Second half......	Torpedoes, dragging for (practical).
Thursday, July 31 (p. m.)	First half.........	Do.
	Second half.......	Search lights (practical).
Thursday, July 31 (evening) .	Half class.........	Do.

CLASS OF GUNNERS.

On the 11th of August the following gunners reported for instruction: J. J. Walsh J. Russell, J. Gaskins, W. Wilson, T. R. Wilson, W. A. Ferrier.

As the course was to cover but one month, it was mainly practical and of a natur suited to the class of officers on shipboard.

The instruction in diving was given under the superintendence of an officer, follows:

In the implements, dress, and signals used in diving, taking apart, cleaning, an assembling the different parts of the apparatus used in diving, and in the necess precautions to be observed when engaged in diving operations.

The instruction in explosives was of a very practical nature, and included t following subjects:

General character of explosive substances; what constitutes an explosive compo and an explosive mixture; how explosive effect is produced; difference betw combustion and detonation, and how the latter is produced; what explosives n be detonated in order to obtain the best results; value of detonation and the rela force of different explosives when detonated and when fired by ignition; mal fulminate of mercury; methods of washing, storing, testing, transporting and h ling fulminates; care of fulminate detonators on shipboard; practical exercis making fulminate detonators; drying detonators; testing when dry; care of de nators; value of fulminate of mercury as a detonating agent for high explosives.

Gunpowder.—Influence of size and shape of grains and method of ignition on effect produced; value of special shapes, such as spherical, hexagonal, prisma

Nitro-glycerine.—A brief explanation of the manufacture; experiments show properties; care of nitro-clycerine; storing, testing, washing if impure; fre thawing, transporting, exploding, when liquid; when frozen; safety when fr uses of nitro-glycerine; practical exercises in exploding and handling; precautio to be observed; danger when exposed to shot.

Dynamite.—Care of and preservation; storing, inspecting, testing, transporting danger from exudation of nitro-glycerine; signs of decomposition; frequency

ination; effect of heat and cold; safety of dynamite over liquid nitro-glycerine; when exposed to shot; uses above and below water; exploding soft and dynamites.

A practical exercise was given in making and exploding dynamite.

Explosive gelatine.—Manufacture, properties, storing, testing, inspecting, and transporting; effect of heat and cold, decomposition, danger, uses, exploding by Austrian detonator, both above and under water; practical exercise in making up and firing of explosive gelatine.

Gun-cotton.—A brief explanation of the manufacture, different forms of gun-cotton in use, viz, long staple, granulated, disks, slabs, tape, &c.; its importance in warfare, and extensive use in other countries; care and preservation of wet gun-cotton, storing, inspecting, testing; how treated if moldy or shows signs of decomposition; sawing, drilling, turning into special shapes; effect of heat and cold on wet gun-cotton; how carried on shipboard; care of gun-cotton on ships; safety of wet gun-cotton over all other explosives when exposed to fire, shock, blows from bullets, projectiles, &c.; uses of wet gun-cotton, exploding; practical exercises in making up and firing charges of gun-cotton to show how it should be used to destroy guns, blow down embankments, remove rocks, &c., both above and below water; also how it should be used to cut off spars, &c.

Dry gun-cotton for primers, how dried, care in drying, storing, transporting, inspecting, and testing dry gun-cotton; signs of decomposition; how to stop it; packing dry gun-cotton to go on shipboard; care while on board; uses of dry gun-cotton; safety compared to gunpowder.

The instruction in electricity was on the following subjects:

A general explanation in regard to the sources of electricity and the various effects through which it manifests itself. Definition and explanation of the technical terms in common use: Conduction and insulation; circuits, simple, branch, and earth; properties of conductors; laws governing resistance; relation existing between electrometer force, resistance, and strength of current (Ohm's law); a brief explanation of electrical units; voltaic cells and batteries, principles, method of setting up and connecting, care and preservation; magnets and magnetism, principles of magneto-electric induction, and of dynamo-electric machines; full explanation of Farmer's machines; care required and method of finding and correcting faults in them; heating effect of electric currents; fuzes; electric lights, arc and incandescent; search-lights and projectors, especially the Sautter-Lemonnier apparatus now in use in the Navy; simple methods for detecting breaks and leaks in wires and cables and for repairing them; electric bells and thermostats; general principles of electricity in the storage battery.

The instruction in fuze-making consisted in requiring each member of the class to construct igniters, fuzes, electric gun primers, M. E. igniters, and fulminate of mercury detonators.

During all practical exercises igniters and fuzes of their own manufacture, as well electric gun primers, were used.

The instruction in torpedoes was as follows:

The use of gunpowder torpedoes and the knowledge of all appliances used with them in boats and ships following "Torpedo Instructions." (Part I, Spar Torpedo.) In the use of gun-cotton exercise service and contact torpedoes, boat and ship fittings, spars, &c., details of filling, fusing, shipping, handling, testing, and firing; precautions necessary, care of material, and in the details of the gun-cotton outfit for ships.

Practically, each member of the class has been required to splice wires, making all splices generally used, splice on igniters and fuzes, connect up with A and C machines and with firing batteries; use switch boards and terminals in making connections with permanent wires; splice on terminals and electric connectors and repair switch boards. Set up and use the ship's galvanometer in testing for continuity and insulation with its own cell and with battery; use Farmer's machine A and C (and firing key) in exploding igniters and fuzes; fill, fit, and fuze gunpowder torpedoes; take apart, search for faults, and reassemble A machine and firing key and C machine; use the firing plate and firing board, making all connections with the A machine and firing battery; using permanent wires and testing and firing igniters; charge, fuze, and test gun-cotton torpedoes, service, contact, and exercise and explode gunpowder and gun-cotton exercise torpedoes from steam launches; charging, handling, fitting spars, and steering in turn. In this latter instruction the C machine and portable battery were used.

Lieutenant-Commander Newell was detailed to have general charge of the instruction.

Instruction in torpedoes, torpedo outfits, &c., was given by Lieutenant Totten; in electricity by Lieutenant Maynard; in explosives by Professor White, chemist; and Lieutenant McLean had charge of the instruction in fuze-making and diving.

The class of 1884 should be commended for the interest and industry with which they devoted themselves to the course of instruction, and I am happy to say that without an exception were most diligent in their studies.

They were the first class which enjoyed the advantages of thorough exercise with the gun-cotton outfit now supplied to the service, and the practical course of submarine mining was fuller than had been ever attempted before.

Four members of the class were retained to participate in a more advanced course, and I have no doubt that experience will show the wisdom of having a class of officers through the year with more time to develop much that must, from the breadth of the subject, be but slightly dwelt upon in the short summer time.

GUN-COTTON.

The gun-cotton works, in the process of erection at the date of my last report, were completed in the beginning of the year, and an experience of several months has shown no change in the plant to be necessary.

Some 10,000 pounds altogether have been manufactured, and in grade and appearance will compare most favorably with the best English gun-cotton. Five men constitute the force in the works, and as they have now become accustomed to their duties, there will be no difficulty in turning out 200 pounds per month, much more than the present needs of the Navy.

GUN-COTTON OUTFITS.

The gun-cotton outfit is now complete in every detail. Working drawings of every part have been prepared, so there will be entire uniformity in their preparation.

A very successful exhibit of the new contact torpedo was made during the past summer in the presence of the President, Secretary of the Navy, and other distinguished persons, by which the schooner Joseph Henry was completely destroyed from the explosion upon contact of the torpedo from the end of a steel bar.

The total amount of gun-cotton now supplied with the outfit is in the neighborhood of a thousand pounds. It seems desirable that an extra amount should be supplied above that required for the allowance of torpedoes to meet contingencies.

Respectfully submitted.

THOS. O. SELFRIDGE,
Captain, and Inspector of Ordnance, in charge of Station.

UNITED STATES TORPEDO STATION,
Newport, R. I.

SIR: In obedience to the Department's order of July 22, 1884, the Board appointed to witness the examination of the class of officers under "instruction in the use and manufacture of torpedoes at Newport, R. I.," have the honor to submit the following report:

The examination extended over two days, as indicated in the schedule appended, marked A. A portion of the time was taken up by oral answers to questions upon the natures and uses of the various types of torpedoes, upon the science of electricity, particularly in its application to naval warfare, and upon the chemistry of explosives. Practical exercises in illustration were then carried out.

The Board desires at the outset to express its conviction that the officers under instruction have made faithful use of their time and opportunities, but it cannot record its satisfaction with the results of the examination. With few exceptions, the theoretical parts of the course were not shown to have been mastered. The answers were, as a rule, vague and not to the point, impressing the Board with the idea that much effort had been expended in the memorizing of certain dates, facts, and figures, the pith of the matter having been altogether missed. The same remark is largely applicable to the practical exercises.

A glance at the examination questions, appended hereto and marked B, taken in connection with the short time allotted to the instruction in the several branches, will make clear the impossibility to the average mind of attaining even an appro[illegible] to thoroughness in so wide a field of study.

The members of any class, at the Torpedo Station, divide themselves by a nat[illegible] process into two categories—those who care only to acquire a practical wo[illegible] knowledge of the service-torpedo outfits, and those who show the inclination, [illegible]tude, and ability needed in the trained torpedo specialist.

The present course is to the former a useless waste of time and labor; to the l[illegible] a hasty and superficial treatment of a wide-reaching subject.

If a short and purely practical course were established covering the needs of [illegible] first category, the instructor of the station would be in a position to select a c[illegible] number of officers from each class for an extended term of comprehensive tuition, [illegible] theoretical and practical.

ard wishes to state in the most unmistakable manner its opinion of the mode of lecturing. The instructor reads aloud from his manuscript to the he latter write their rough notes, as nearly as may be *verbatim*, from this dic-pying them out smoothly at night. As many of these lectures cover a score f pages in the class-books, it is not to be wondered at that no time is left at usion of the overcrowded day for the study and assimilation of the subjects Indeed, to describe the method is to condemn it.

ard is of the opinion that the French system of "*fenilles autographiées*" should d to eliminate all needless clerical labor and to give the instructor time and ity to elucidate obscure points as they arise. If, also, the plan of allowing nt as "*répétiteur*" in each branch were introduced, the instructor would be f much unnecessary detail now devolving upon him, and gain time for mat-h are of greater importance.

he term of service here extended to four years, each officer could act as as-r half his time before being advanced to the duties of principal instructor. anging of the members of the class in order of merit, by means of recitation ars hardly upon the older students, who have frequently lost their school-its of study, but also who are none the less diligent and attentive. In the f the station it has been the almost unvarying experience that officers or instruction have not needed the stimulus of emulation to make them earn-eir efforts to acquire knowledge of an important branch of their profession. ard is therefore of opinion that a bare certificate of proficiency would suffice. r to secure uniformity of method and a well-considered balance among the dif-tters taught, it is suggested that a board be formed of the instructors, with ctor in charge of the station as president, to regulate the details of the cur-

Although technical in its nature, the Torpedo Station would, it is thought, the adoption of this plan, which is common to institutions of learning the er.

re the honor to be, sir, very respectfully, your obedient servants,

S. R. FRANKLIN,
Commodore, United States Navy, President of the Board.
J. H. SANDS,
Commander, United States Navy, Member.
C. F. GOODRICH,
Lieutenant-Commander, United States Navy, Member.

EF OF THE BUREAU OF ORDNANCE,
Navy Department, Washington.

UNITED STATES, TORPEDO STATION,
Newport, R. I., August 1, 1884.

DORE: I have the honor to submit to the Board the following programme les:

1: 10 a. m., examination in electricity till noon; 1 p. m., examinations in till 3 p. m.; 3 p. m., practical work with torpedoes.

2: 10 a. m., examination in explosives, some experiments with gun-cotton; xperiments with electric lighting and torpedoes.

nation in fuze room.

pectfully, your obedient servant,

THOS. O. SELFRIDGE,
Captain, and Inspector of Ordnance, in charge of Station.

dore S. R. FRANKLIN, U. S. N.,
sident of the Board of Visitors, Torpedo Station.

EXAMINATION QUESTIONS.

TORPEDOES, 1884.

lain the gunpowder service torpedo, construction, sizes, how used from l ships, how prepared, handled, and fired. Explain the outfit for gunpowder (omitting the galvanometer).

al.—Explode from a boat a service 75-pounder gunpowder torpedo, using a e.

lain the gun-cotton service torpedo, construction, how used from a ship, how handled, and fired. Explain the gun-cotton torpedo outfit (omitting the orpedo, boat and fittings, galvanometer).

Practical.—Explode from the Triana an exercise gun-cotton torpedo, using the A machine and firing key.

3. Explain the *contact* gun-cotton torpedo, construction, how used from a boat, how prepared, handled, and fired. Explain the boat torpedo fittings for gun-cotton.

Practical.—Connect up the contact torpedo, introducing a bell in the circuit, and show its working (in the museum), using the immersion battery and switch-board.

4. Explain the testing and firing plate, construction, use with machine and battery.

Practical.—Prepare and fire from Triana a service 100-pounder gunpowder torpedo, using the A machine and plate.

5. Explain the ship galvanometer, construction, and use.

Practical.—Set up the galvanometer and explain how used.

Explain the testing and firing board, construction, use with machine and battery.

Practical.—Prepare and fire from Triana an exercise gun-cotton torpedo, using A machine and board.

6. Explain the general principles involved in the defense of a port or channel by *purely electrical* torpedoes, referring specially to the cases, kind of torpedoes, moorings, cables, junction boxes, disconnectors, planting, charges and effective depths, radius of destructive effect and necessary intervals, giving the reasons for each, and the advantages and disadvantages.

Practical.—Prepare and fire from a boat an exercise gun-cotton torpedo, using the immersion battery.

7. Explain mechanical and electro-mechanical types of defensive torpedoes, advantages and disadvantages, how used in a defensive system. What other means will be employed to strengthen a submarine defense, how will these be utilized and where placed.

Practical.—Show the working of explosive grapnels.

8. Explain the general principles of electrical torpedoes in a defensive system, and how the position of a vessel with reference to any torpedo can be determined. Explain the methods of firing by observation, advantages and disadvantages. Then explain the Shutter arrangement where a vessel is made to signal her own position, advantages and disadvantages.

Practical.—Connect up and show working of the Shutter apparatus (in museum).

9. Explain the McEvoy single main system, his circuit-closer, junction-box, and firing-table.

Practical.—Connect up the apparatus in the museum, and show the working of the same.

10. Explain the proposed methods for the removal and destruction of channel obstructions and clearing a channel of torpedoes.

Practical.—Prepare and explode from a boat a service gun-cotton torpedo, using the immersion battery.

11. Explain the different methods for mechanically or electrically controlling boats; what use can be made of them. Give a concise description of the fast torpedo boat, showing the conceded requirements, and how fulfilled.

Practical.—Connect up and illustrate the use of two testing and firing boards (in museum).

12. Give a general description of the Whitehead torpedo, what is claimed for it, shape, construction, speed, and how it is projected from large and small vessels (not giving the details of the starting, stopping, sinking, firing, and immersion mechanism).

Practical.—Connect up and show the working of the electrical switches, permanent wires, and terminals usually found on a ship.

13. Explain the mechanism that controls the starting, stopping, sinking, and firing of the Whitehead torpedo.

Practical.—Prepare and fire an exercise gunpowder torpedo from a boat, using the C machine.

14. Explain how in the Whitehead torpedo a straight course and constant depth are maintained.

Practical.—Locate and correct faults that may occur in the C machine.

15. Explain the Lay-Haight (controlled) movable torpedo, construction, arrangement, details of the different parts, and method of controlling the movements of the torpedo.

Practical.—Connect up the apparatus used in controlling the boat and show its working.

16. Explain the McEvoy duplex spar torpedo, and how used.

Explain drifting torpedoes—submarine boats and projectiles—rocket torpedoes, hand grenades and darts.

Practical.—Fire from Triana a *service* gun-cotton torpedo, using the testing and firing plate with a battery.

17.—Explain the proposed methods of defense against offensive torpedoes, and give also your views of the best plan for conducting an attack with the same.

Practical.—Rig and operate Captain Selfridge's plan of defense.

ite into what classes are torpedoes divided, what are the principal types, and l be required of the Navy with regard to torpedoes. Give a general idea of orpedoes, including the Harvey, French, Danish, and German types. How operated, and with what favor are they now held?

st.—Show how the D. E. machine (A) and firing-key are used, and how faults may be located and remedied in those D. E. machines furnished the

FUZE-MAKING, 1884.

:ribe the construction and use of the M. E. igniter.
ribe the construction and use of the D. E. igniter.
ribe the construction and use of the D. E. fuze.
:ribe the construction and use of the D. E. detonator.
ribe the construction of the D. E. cannon primer.
ribe and illustrate the measurement of igniter bridges for inspection.

ELECTRICITY, 1884.

it is meant by electro-motive force? What is the difference between the otive force of a battery and the potential difference between its terminals closed circuit? How measure the E. M. F. of a battery?
it is meant by electrical resistance? Upon what does the resistance of a r depend? What effect does a rise in the temperature have upon the resist- lifferent conductors?
ite the resistance at 15° C of 1,000 yards of copper wire, one-tenth inch diam- se conductivity is 95 per cent. (the resistance of 1 foot of pure copper wire, sandth inch diameter, at 0° C is 9.72 ohms.
w by a diagram the principle of Wheatstone's bridge.
a bridge and measure a resistance.
:ribe Conden's method of measuring the electro-motive force and resistance ery.
the apparatus and measure the electrical dimensions of a given battery.
it are the defects of a simple zinc-copper acid battery? How are these de- edied in the Daniell's cell?
maximum current will a battery of 12 Daniell's cells send through a galvan- f 50 ohms resistance shunted with a resistance of 2 ohms, if each cell of the has a resistance of 3 ohms, and the leading wires to the galvanometer a re- of 2 ohms? How must the cells be arranged?
at qualities are essential in a battery to be used for torpedo firing? Of the wn batteries, which are the best adapted to the purpose? Describe the M. l.
cribe the station immersion battery. What liquid is employed in it? Call- esistance of the battery 1 ohm and its E. M. F. 7 volts, calculate the maxi- nber of service fuzes it will fire simultaneously.
it is a voltameter? Describe the construction of the one at this station. y the range of the instrument be extended?
:rence of potential of 75 volts will produce a deflection of 45° on a certain er, whose resistance is 400 ohms. If an additional resistance of 500 ohms be :d in the voltameter circuit, to what potential difference will a deflection of spond?
it is a secondary or storage battery? Upon what principle does the storage in the secondary battery depend?
ige battery of 20 cells, each having an electro-motive force of 1.9 volts and a e of .003 ohm, is employed to feed incandescent lamps which require 35 volts ampires each. What is the maximum number of lamps that can be supplied battery?
iat is an electro-magnet?
length of copper wire, whose diameter, including insulating covering, is .01 l be required to wind a bobbin 2 inches long, 1¼ inch outside diameter, and side diameter?
on what does the heat developed in a circuit depend?
ite the diameter of a copper wire, which, when freely exposed to the air, will urrent of 1,000 ampires without increasing in temperature more than 75° C. resistance, 1.65 microhms.) ?
iat qualities are most desirable in a material for making the bridges of What materials have been found the most suitable, and why?
n the method of calculating the number and arrangements of fuzes which :ed simultaneously from a given source of electricity.

13. What is a dynamo machine? Upon what principles does its action depend What is a series dynamo? a shunt dynamo? a compound wound dynamo? (Diagram showing the winding of each.)

What considerations should govern in selecting a dynamo for use on board ship?

14. Describe the Farmer's A machine and firing-key. What is the object of the short circuit in the latter? How does the c machine differ from the a?

15. In order to determine the electro-motive force of a dynamo machine, what measurements would you make? How calculate the E. M. F.?

The speed of a dynamo is kept constant, while the external resistance is diminished gradually. Explain how the E. M. F. of the dynamo and how the potential difference at the terminals will vary (1) when a series dynamo (2) when a shunt dynamo is employed.

16. Describe in detail the experiments you would make to determine the efficiency of a dynamo.

17. Distinguish between arc and incandescent lighting. State to what purpose each is best suited. Show the method of arranging the circuits of the two kinds of lamps. Describe the construction of an incandescent lamp.

18. What is an electro-motor? What is the law of efficiency of a motor? What is the law of maximum work?

Describe the torpedo search light as arranged at this station, including motor, shunt, &c.

19. Describe the search light of Sautter-Lemonnier & Co., including dynamo, engine, lamps, and projectors.

20. Explain the principles of the induction balance. Describe McEvoy's submarine detecter. Set it up and operate it.

EXPLOSIVES, 1884.

1. Give general composition and properties of explosive substances and the characteristics of an explosive reaction; also distinguish between explosive mixture and explosive compound.

2. Discuss physical state, external condition, mode of firing, and show value of detonation.

3. Preparation and purity of material for the manufacture of nitro glycerine.

4. Manufacture of nitro-glycerine, Marbray's and Nobel's method.

5. Nitro-glycerine, properties, transporting, storing, inspecting, exploding, and uses.

6. Dynamite composition, manufacture, properties, exploding soft and frozen, advantages over explosive mixtures.

7. Explosive gelatine composition, manufacture, properties, storing, exploding (Austrian detonators), advantages over dynamite.

8. Gun-cotton, preparation of materials.

9. Dipping, cooling pits, reaction of formation, extracting the acids, immersion, wringing, boiling.

10. Pulping, poaching, adding alkali.

11. Testing the pulp, heat test, solubility test, testing the finished gun-cotton.

12. Molding and pressing gun-cotton pulp.

13. Sawing, drilling, treating with carbolic acid solution, packing, storing, transporting, inspecting wet gun cotton.

14. Drying primers on board ship, packing, storing, transporting and testing dry gun-cotton primers.

15. Exploding wet and dry gun-cotton, advantages of gun-cotton over all other explosives for torpedoes.

16. Fulminate of mercury, manufacture, composition, uses, and care.

17. Liquid carbonic acid, manufacture and uses in torpedo warfare.

18. Gunpowder, manufacture, compare with high explosives, and show adva[illegible] of the latter for torpedo service. Discuss size and form of gunpowder grains.

TORPEDO STATION, *Newport, R.*

SIR: We beg leave to submit the following report of trials of dynamo-electric [illegible]chines, lamps, projectors, &c., made in compliance with your orders of March 28 31 and April 2 and 11:

SAUTTER, LEMONNIER AND CO.'S SEARCH-LIGHT APPARATUS.

This apparatus comprises two Gramme dynamos; one Brotherhood engine for d[illegible]ing both dynamos; two electric lamps, hand regulators; one electric lamp, autom[illegible]

:; two Mangin projectors; one commutator for directing the current from ıamos into the same exterior circuit, or the current from each dynamo into ıxterior circuit; two single conductor cables; two double conductor cables; ɔmeter for indicating the rate of revolution of the dynamos; one supply-box ıg spare collector brushes for the dynamos, couplings for the cables, colored s, screws, &c., for observing the arc, pliers, screw-driver, fine sand-paper, nd linen tape, &c.

THE DYNAMOS.

ıre of the type designated by the makers as "C. H. C. T." The armature is tions; its resistance is 0.24 ohms. The field magnets are in eight parts, four ıd four below, each four terminating in a common pole piece. The field-mag- are joined four in series and two in arc, and are in the same circuit as the ɔ and external circuit. The resistance of the field magnet circuit is 0.60 The collector brushes are flat bundles of tinned copper wires, carried in holders set screws to brass rods projecting from the cast-iron neutral pieces of the gnets. The outer ends of these rods carry a gear, operated by an endless ı that each brush is independently adjusted.

afts of the dynamos revolve in brass bearings which have oil receptacles in 'er parts. On the front of each dynamo is an ebonite plate bearing two stout binding screws, marked P and N, respectively, and a switch for breaking the t this point. The negative brush of the collector is connected directly with inal marked N. The positive brush is connected with one end of the field- ircuit, the other end of this circuit being connected with the terminal marked holder of the positive brush also carries a stout binding point.

ynamos and the motor are mounted on one cast-iron bed-plate, the motor aced between the dynamos and all three shafts in line. The shaft of each of ımos is joined to the shaft of the engine by means of two bolts, which are threads and nuts to a flange on the shaft of the dynamo, and which have al heads fitting into cylindrical holes in flanges on the ends of the motor By this arrangement an exact alignment of the three shafts is not absolutely y.

le dynamo, operating its lamp, when driven at an average speed of 665 revo- per minute, developed an average current of 43.4 ampères, with an average l difference at the terminals of 48.7 volts. The resistence of the external cir- ch included 100 meters of cable and an anometer (resistance .053 ohms, equiva- 0 meters of cable) for measuring the current, was, therefore, $\frac{48.7}{43.4}$=1.13 ohms. he two dynamos supplying one lamp the average current generated, at an speed of 660 revolutions, was 77.8 ampères, with a potential difference of 61.2 the terminals.

'namos ran without undue heating, and, after several hours' run, a thermom- upon the hottest parts of the coils showed a temperature of 110° to 130° F. king at the brushes is not great when the brushes are properly set, and there ıbt that the collector is sufficiently substantial to last much longer than an cruise.

THE ENGINE.

rotherhood engine has three single-acting cylinders of seven inches diameter ıches stroke, placed at angles of 120° with each other in a vertical plane at gles with its shaft, one cylinder being vertically above the shaft. The three s and the crank chamber are cast in one piece, leaving apertures in the sides, ıd back for assembling and adjusting the internal parts. The apertures at the l back are closed by plates, bolted on, which can readily be removed. The rs of the crank chamber are also bolted on and contain the Babbitt metal of the shaft. The bearings of the shaft, crank, and connecting rod are lubri- a mixture of oil and water contained in the crank chamber, which is dashed direction by the moving part. A small trough, with a pipe leading to the of the shaft bearings, is fitted in the upper part of the crank chamber to in- proper lubrication of the bearings.

stons are cup-shaped to obtain long bearings, and are connected to the crank w steel rods, having bronze bearings at each end. Those at the crank are f cylinders held to the crank-pin by two circular straps bolted together and ; the ends of all three sectors. As the connecting rods and bearings are al- compression when the engine is working, the bearings may become consider- n without affecting the smooth working of the engine.

ıd of the engine shaft extends a few inches outside of its bearing and carries e-wheel, at which connection is made to the left-hand dynamo as already de- The other end of the shaft extends only to the outer end of its bearing and t, square in section, cut across it. A similar slot is cut across the end of the

valve and governor shaft. Between the slotted ends of the two shafts is fitted a steel disk, having its opposite faces at right angles with each other, projections corresponding with the slots, the whole forming a kind of universal joint.

The valve is circular, hollow, and made of bronze. It is driven by projections on its shaft fitting into two slotted lugs in the valve, so that the shaft may be a little out of line without cramping the valve. The valve-chest is bolted to the end cover of the crank chamber, a tarred-paper gasket being interposed to prevent the cover being pressed too tightly on the valve. Steam enters the valve through its hollow axis, and is distributed to the cylinders in succession as opposite apertures in the two faces of the valve uncover pairs of steam-ports in opposite ends of the valve-chest, each pair having a common communication with the corresponding cylinder. Three small holes ($\frac{1}{16}$ inch diameter) in the valve behind the steam-ports facilitate warming and turning over the engine before setting it at full work. As the valve rotates the steam-ports are followed by exhaust ports, through which the exhaust takes place into an annular space surrounding the periphery of the valve, and thence into the exhaust pipe. The admission ports in the valve are cut of such length that the steam is cut off at about three-eighths of the stroke, but in case of the available pressure becoming lower than that for which the motor is designed (45 to 50 pounds), the ports may readily be lengthened so that steam shall be admitted for any portion of the stroke as may be required.

The shaft for the valve and governor passes through a bearing in the valve-chest cover, just outside of which it is fitted with the governor. This consists of two masses of metal inclosed within a metal drum secured to the shaft, which are thrust away from the shaft by the centrifugal force due to rotation. The thrust is communicated to a collar on the shaft by means of bell-crank levers and rods, the collar being connected with the forked end of a lever which, at its other end, is connected to the steam of the governor valve. A spiral spring at this end of the lever tends to keep the governor valve open in opposition to the thrust of the governor, the two opposing forces being equal when the rate of revolution is that for which the tension of the spring is adjusted. The tension of the spring is regulated by turning a milled-headed nut.

With 51 pounds boiler-pressure, the engine driving both dynamos, each supplying its lamp, the speed momentarily increased from 600 to 725 revolutions when one lamp was extinguished, and then fell to 675 revolutions, at which it remained steadily. When the whole load was thrown off by breaking the circuit of both lamps, the increase of speed was slightly greater. It is evident that as the rate of revolution varies the position of the throttle (governor) valve must be varied; that the speed of the engine must vary to produce changes in the position of the throttle; and that the greater the differences of pressure, within the limits of which the engine is designed to run, the greater must be the range of the throttle and the range of the speed of revolution within which the engine may vary when the load is suddenly changed. Suppose, for example, the governor adjusted for a pressure of 60 pounds per square inch, and a speed of 650 revolutions per minute. A comparatively small opening at the throttle will admit sufficient steam to drive both dynamos at full power, and a small increase in speed (as in case the circuit of one dynamo is broken) will close the throttle so as to admit only sufficient steam to drive one dynamo at the slightly increased speed necessary to cause the governor to hold the throttle in the new position. But it is evident that with a lower pressure of steam and the same adjustment of the governor more motion of the throttle and greater differences of speed would be required. These differences would be still further exaggerated by sudden variations from full load to no load, as may happen from breaking of the carbons or careless attendance when using both dynamos on one light circuit. For regular and proper working of the dynamos the attendant should adjust the governor occasionally as the conditions of working vary. With a little practice this may be done as readily as opening and closing the stop valve in the steam pipe.

One of the principal features of the governor of this engine is its direct attachment to the moving part of the speed of which is to be regulated, by which means the possibility of irregular action from the slipping or breaking of belts is avoided. The principal moving parts of the governor are inclosed in a metal case and thus are free from accidental derangements.

The space occupied by the dynamos and engine, including all projections, is 8′ 1″ long, 3′ 1″ wide, and 3′ 4½″ high. The bed-plate is 2′ 1″ by 8′ 1″, the ends the two lower cylinders projecting over the bed-plate 6″ on each side. The he 2′ 8″, except at the center, where the upper cylinder, including the drain-cock, r a height of 8½″ above the dynamos. The bed-plate is bolted to a two-inch pine f overlaid with tongued and grooved flooring, no special foundation being requ The engine runs at a speed of 650 revolutions without great vibration. To dr at this speed when operating two lamps a minimum boiler-pressure of 45 pound required. The engine being located at a considerable distance from the boi pressure at the engine is probably less than 45 lbs.

THE LAMPS.

• three lamps, two being for general use (one for each projector) and re-
lation by hand, the third being an automatic Serrin lamp for special use
.jector.
and-fed lamp the feed mechanism consists of a rod on which two screw-
cut, one double the pitch of the other. The coarser thread advances the
on-holder, the finer that for the lower carbon. Two simple attachments
er carbon-holder enable the upper carbon to be adjusted so as to keep the
in the desired position. The length of the arc is adjusted by turning a
ne feed-rod, and the arc is kept in the axis of the projector by turning a
l on the side of the lamp which, through a screw gearing, elevates or low-
ole of the feed-regulating apparatus and carbons together.
liar feature of these lamps is that they are inclined so as to bring the axis
bons at an angle of about 20° from the vertical, and by a slight dis-
of the upper carbon to the rear the incandescent face of the carbon is kept
he vertical plane or parallel with the reflecting mirror in the projector.
gement is evidently very superior to others in which, while the carbons
arly vertical, a similar displacement of the upper carbon to the rear places
scent face of the carbon in a plane inclined to the reflector. With a proper
the whole, or nearly the whole, of the face of the upper carbon is directly
ard the reflector without being screened by the point of the lower carbon.
th of the arc should be kept at one-seventh to one-fifth of an inch when
used in the projector in order to keep near the focal point of the mirror;
if the arc be increased in length) there will be a great deal of extra focal
n on surrounding objects near the projector and for some distance on ob-
n the path of the proper beam, greatly lessening the observer's apprecia-
tant illumination. When not in use in the projector the arc may be in-
any length within the limits of extinction (depending upon the electro-
ce at the lamp) found to give the best illumination for the circumstances.
p is placed in the projector with the face of the positive carbon toward
that is, turned away from the mouth of the projector, as otherwise a large
the rays would escape in divergent directions, thus illuminating a large
the projector, where it is not only not required, but where it is actually
l. A small circular screen in the lamp prevents any rays escaping directly
e mouth of the projector.
ons for the lamp are 18 millimeters (0.7 inch) in diameter. The positive
oated with copper, while the negative carbon is not so coated. The car-
r to be of good quality, but want of homogeneity was noticeable.
matic lamp is of the well-known Serrin type. The upper carbon can be
as in the hand lamp, but as the axes of the carbons are vertical, the light
ositive carbon cannot be thrown upon the mirror at a safe angle. This
o provided with an attachment by which the entire system of feed rods
ed or lowered, so that the arc may be adjusted in the axis of the projector.
with all automatic feeding lamps it requires attention to keep the dis-
of the upper carbon right for producing the most light, and for the same
at obtain with hand-fed lamps, viz, want of perfect homogeneity in the
regular burning at the back and front, and the fact that the axis of the
on is inclined to that of the lower, thus reducing the actual displacement
er carbon in the direct ratio of its consumption.

THE PROJECTORS.

jector consists of an iron cylinder, with a reflecting spherical mirror at one
circular glass door in a brass frame at the other The projector is fitted
oved arrangement for receiving the lamp and permitting it to be moved
n the mirror for focal adjustment by a screw fitted with a hand wheel.
part of the lamp extends below the body of the projector, so that the hand
regulating the length of the arc and its adjustment to the focal axis of
may be manipulated without opening the projector door. On the side of
or is an observation tube for observing the condition of the arc, contain-
at its inner end and a prism and a screen of dark glass at its outer end,
image of the arc and carbon points is visible to the attendant standing at
the projector. In the center of the mirror is a small circular sight-hole,
a shade of dark glass, through which the condition of the carbon points
erved directly.
ector is provided with apertures for ventilation, covered by sheet-copper,
e the surface of the cylindrical body. It is mounted by trunnions on an
ich turns on a hollow cast-iron pedestal. To the right-hand trunnion is
evating screw, which can be thrown out of gear by moving a clamp, thus

permitting a movement of the projector through large vertical angles by hand directly. Between the base of the Y and the top of the pedestal are four friction rollers, so that movement through horizontal angles is easily effected by hand. A friction clamp is fitted to the top of the pedestal for controlling the movement of the projector about its vertical axis. The pedestal is fitted with two binding posts for the cable conductors and a switch for putting in or cutting out the lamp. Circuit connections between the pedestal and the lamp are made by spring contact posts pressing up against two concentric rings of brass in the under side of the base of the Y, both posts and rings being well insulated. The spring contact posts are connected with their corresponding binding posts by insulated copper ribbons. The concentric rings are connected by similar insulated ribbons of copper, led through the hollow arms of the Y, and making rubbing contacts with other and similar ribbons leading inside the projector to the lamp contacts. This arrangement would permit, if required, a continuous rotation of the projector about a vertical axis.

The special and principal feature of this projector is the reflecting mirror, the invention of Colonel Mangin, of the French army engineers. This consists essentially of a spherical mirror, the two faces of which are ground to portions of surfaces of spheres of different radii These radii are found by calculations based upon the required dimensions of the projector and the refractive index of the crown glass used. The back of the mirror is silvered, as usual. The mirror has the form and properties of a concave-convex lens until it is silvered, when its action changes as follows: A ray of light proceeding from its focus is, on entering the glass, bent by refraction toward parallelism with the axis of the mirror; it is then returned by reflection in a direction more nearly parallel with the axis, and, on emerging, is again refracted in a direction sensibly parallel to the axis of the mirror. All of the rays reflected from the mirror, when the luminous source is at its focus, will therefore unite in a nearly cylindrical beam of light.

Both design and construction of the Mangin mirror are as simple and efficacious as can well be. Experience has shown that ordinary spherical mirrors cannot be used as powerful reflectors on account of spherical aberration; metallic parabolic mirrors can only be constructed in perfect form with very great difficulty, and cannot be maintained in the form which they are constructed; a parabolic mirror of glass would retain its form, but would be almost impossible to construct. The Mangin mirror, however, is an almost exact equivalent for a glass parabolic mirror. The amplitude of the beam and the areas of illumination may be varied, whithin certain limits, by moving the source beyond the focus. For obtaining larger areas of illumination a diverging lens is supplied. This consists of a series of plano-cylindrical lenses, arranged with their axes vertical, in a circular brass frame. When in use, it is hung over the glass door by holes in its frame fitting over hooks on the projector. The diverging lens increases the width of the field, but not its height, changing the section of the beam from a circle to an ellipse. By its use is avoided great illumination of near objects, which would result from an attempt to increase the illuminated area by moving the voltaic arc out of the focus of the mirror. The diverging lens increases the divergence of the beam in the horizontal direction to 15°, leaving the vertical divergence at the normal 2°.

The diameter of the mirror is 60 centimeters (23.62 inches), from which the apparatus is called a 60-centimeter projector. The focal distance of the mirror is 332 millimeters (13.07 inches).

The projector is fitted with an opaque screen, which may be interposed between the arc and the mirror by operating a short lever on the exterior of the projector, and may thus be used for signaling. The sharply defined character of its projected beam makes it peculiarly adapted to this purpose.

THE COMMUTATOR.

This is for the purpose of instantly changing the ordinary arrangement of the circuits (in which each dynamo is in circuit with and supplies current for its own lamp) to the special arrangement in which the two dynamos are coupled in arc, and supply current for but one lamp. By a reversal of the commutator the first arrangement is restored.

The commutator consists of a rectangular ebonite plate, on which is mounted in brass supports an ebonite cylinder, at one end of which is an insulated handle for turning the cylinder through 90°. Upon the ebonite plate are five copper-plates, three of which extend across the ebonite plate below the cylinder and at right-angles with its axis. The two other plates lie directly opposite each other on different sides of the cylinder and terminate in springs, by which they may be put in metallic connection with a copper plate on the cylinder itself. The plate nearest the cylinder-handle has two binding posts at each end, those at one end being respectively connected to the negative poles of the two dynamos, thus making the plate the common negative pole of the two machines. The two plates crossing at the other end of the cylinder

only one binding post at each end, and one end of each being connected to the ive pole of one dynamo, these plates become practically the positive poles of the mos. Connections with the two lamps are made from the remaining binding posts. :wo shorter plates in the middle are connected to the positive brushes (not poles) e two dynamos respectively. Each dynamo and its lamp are now in a separate independent circuit, except that the negative plate on the commutator forms a of each circuit. In order to put both dynamos in arc on either lamp, it is necesnot only that their like poles shall be joined, but that their similar brushes also be joined, for the purpose of equalizing the potentials at the ends of the coils of the two dynamos, and thus preventing the reversal of the field of either. is effected by rotating the ebonite cylinder through 90°, when a plate upon it 's metallic connection between the two positive poles (the negative poles being dy united), while a second plate on the cylinder connects the springs of the plates ected with the positive brushes of the dynamos. When this is done the lamps also be connected in arc, and that having the longest arc will in general go out, the light from the other will be very much increased.

the first experiments with the commutator it was found that in several in-es one or the other of the machines was reversed in polarity and both lamps ved of the current. These reversals took place when but one of the lamps was eration at the time the commutator was moved, except in one instance (reported ie member of the board), when, both dynamos being already supplying current ie lamp, that lamp was, by negligence of attendant, allowed to go out. The ns for these reversals were not discovered, the condition of the circuit and of ommutator being, so far as we know, the same at all times. The fact that they occur we consider a disadvantage, though not sufficiently great to condemn the ument for the use for which it was intended.

THE CABLES.

ur lengths of cable are included in this apparatus—two lengths of 50 meters (164 each contain two conductors, and two lengths, also of 56 meters each, a single uctor.

e conductors are strands of seventeen copper wires of about No. 19 B. W. G., 'alent in conducting capacity to a single wire of 0''.17 diameter, the diameter of trand being 0''.1875. The conductors are covered with a parceling of cotton with and united together by Chatterton's compound; the parceling is served a strand of flax yarn, and over all is braided a covering of hemp which is soaked ockholm tar. In the two conductor cables the outside braiding of hemp incloses conductors in one. The diameter of the single cables outside the insulation is t 0''.4. The resistance of each conductor is 0.055 ohms (for 50 meters): its con-.vity is, therefore, about 98% of that of pure copper.

e cables are very pliable, and the insulation seems to be all that is required. A length of the cable was soaked for twenty-four hours in sea-water without any urable reduction of its insulation resistance. It is probable that the cable d answer very well for use on board ship. We are unable to come to a more ite conclusion without actual experience with this cable. The double-core form s to possess considerable advantages, viz, the greater ease with which the con-ors can be run on board ship, and the fact that they will exercise no magnetic n on the compasses, even when carrying the largest currents.

THE TACHOMETER.

is instrument, although not an essential part of the search-light apparatus, is a great convenience, as it shows at all times, except at the instant of sudden and changes, the rate of revolution of the dynamos to a very close approximation. placed on a bracket on a wall near the dynamos, and is driven by a belt going the coupling flange of the shaft of the right-hand dynamo. It could be placed bulkhead on shipboard, or even on the bed-plate of the engine and dynamo. Its n is similar to that of the governor, a rod being pushed in one direction by a g and pulled in the opposite direction by the centrifugal thrust of two revolving es of metal. A simple connection between the rod and a pointer, which tra-s a plainly marked dial, causes the pointer to indicate, like a spring scale, the l corresponding to the pull. Its indications are easily read and are particularly ceable in enabling the attendant to maintain the desired speed of the dynamos r varying pressures, &c., by occasional adjustments of the governor and stop-:. Repeated comparisons of this instrument with a speed counter of the ordinary timed by a watch showed that its indications are very accurate. Each part of utter-Lemonnier search-light apparatus is complete in itself, and appropriate o particular functions it performs, so that it may be used with other search-light

apparatus, if required. The design and construction of the apparatus embrace every necessary detail. Several drawings of parts of this apparatus, with descriptions of the "model of 1881," have been published in the report of the Chief of the Bureau of Ordnance, Navy Department, 1882, pp. 67-70.

THE BRUSH DYNAMO.

The Brush dynamo is of the size known as the No. 7 or 16-light machine, but is specially wound to furnish the current for two powerful arc lights in series. A spe feature which distinguishes it from the previous forms of the Brush machine is construction of the armature core. This, instead of being of cast iron, grooved slotted to prevent heating, is made in the form of a coil of sheet iron, secured to a foundation piece of wrought iron. The sheet-iron coil is made up as follows: A ribbon of Swedish sheet iron 1¼ inches wide has riveted to it transversely strips of same material 5½ inches long and of varying width, placed in such numbers and at such intervals along the ribbon that, when the latter is rolled upon itself in the f of a ring, the transverse strips come one above the other, and thus widen the except at eight points equidistant from each other, at which it has only the w the ribbon. Eight spaces are thus formed in the side of the ring, in which are the armature coils. Each turn of the ribbon, with the transverse strips, is cov with a varnish which insulates it from the neighboring turns. Ventilation is provided for, as well as the prevention of induced currents, which would injuri heat the core. The core is firmly secured to radial arms projecting from a ce hub, the latter being secured upon the shaft by set-screws.

The eight coils of the armature are connected in pairs, each coil and the one dia rically opposite forming a pair. The average resistance of each pair of coils is ohm. By the arrangement of the commutators, that pair of coils in which no i tion is taking place is cut out of the circuit, and the remaining pairs are so conn that one pair is in series with two pairs in arc. The resistance of the armature when the machine is in operation is therefore 0.12 + 0.06 = 0.18 ohm.

The field magnets are four in number, the cores being massive, of cast iron, with extended pole pieces, each of which embraces about three-eighths of the an breadth of the armature. The cores of the two magnets nearest the engine are b to the frame of the engine, the other two being connected by an iron casting. four field coils are joined in multiple arc. Their joint resistance is 0.44 ohm total resistance of the machine being 0.62 ohm.

The dynamo was designed by the makers to give a speed of 750 turns, a cur 50 ampères, with a difference of potential at the terminals of 145 volts, or 60 am with a difference of 120 volts at the terminals. The calculation of the el energy in horse-power in the external circuit from these data give the results:

1. 145 volts × 50 ampères × .00134 = 9.715 H. P.
2. 120 volts × 60 ampères × .00134 = 9.648 H. P.

The results of the measurements made by us show that, with an average speed of 628 revolutions, more than 100 revolutions below the speed for which the dyn designed, the average electrical energy developed in the external circuit is 9 power. Or, if we consider the measurements of May 19 and 20 alone, with an age speed of 627 revolutions an average of 10.1 horse-power was developed in external circuit. There is no doubt, therefore, that at a speed of 750 revo much more than the designated energy would be developed.

The machine runs without excessive sparking for a dynamo of this type, and requires no particular care after the brushes are once set. It is found by experience that if the brushes are set sufficiently far forward to reduce the sparking to the least possible, "flashing" will occur at times, and the electromotive force developed is not so great, for the same speed, as when the brushes are not so far advanced. After several hours' run the armature and field coils were not heated to an undue extent. A thermometer laid on those parts which seemed hottest to the hand indicated 120° to 130°.

The commutators are substantial pieces of copper, and would, without doubt, last during a cruise. The brushes are of spring copper cut in strips, and may be readily replaced when worn out. Each pair of brushes is carried in a brush holder, which can be revolved about the commutator so that both brushes are set at the same time.

THE WESTINGHOUSE ENGINE.

This engine has two single-acting cylinders 7 inches diameter and 5 inches stroke. The pistons are of the trunk form, giving long bearing surfaces, are double walled at the top, and operate downward. The axes of the two cylinders are in the same vertical plane, which plane does not pass through the axis of the shaft, but lies to

one side of it at a distance equal to one-half the crank radius. The cranks are set at 180°. The valve is of the piston form and balanced, taking steam at its middle part and exhausting at the ends. Its guide is a piston traversing a cylinder separating the exhaust space from the chamber below. This chamber incloses the cranks and the valve gear. It is partially filled with water and oil for the lubrication of the working parts of the engine. The cylinders are cast in one piece with the valve mber and are bolted to the crank chamber. The crank chamber is closed at the s by flat bonnets bolted on, which can be removed readily for the examination ad adjustment of the working parts of the engine. The lower ends of the cylinders pen directly into the crank chamber.

A peculiarity of the engine is the annular exhaust, which surrounds the cylinder d opens into it by a set of exhaust ports around the bottom of the cylinder. These haust ports are opened by the piston uncovering them at the end of its downward roke, thus throwing at once the whole cylinder open to the exhaust. The motion of valve is controlled by an eccentric on the shaft. It is set to cut off at $\frac{7}{10}$ of the tive stroke of one piston and $\frac{8}{10}$ of that of the other, but may be adjusted to admit am through a larger part of the stroke, thus enabling the engine to do the required ork with somewhat lower steam pressure. The eccentric and cranks are balanced by bs cast on them. The eccentric and connecting rods are hollow, of malleable iron. he crank pins are of steel.

The engine makes direct connection with the dynamo, the shafts of the engine and namo being in one. The shaft bearings are in the form of removable shells and d with Babbitt metal, that between the crank and the armature being lengthened. bearings are tapered, thus permitting the taking up of wear by adjusting the eve. They are provided with oil cups for lubrication in addition to the lubrication aich takes place from the oil which finds its way out from the crank chamber.

The Waters governor is supplied to the engine, the governing being effected by controlling the admission of steam to the cylinders. The governor is run by a belt from he shaft of the engine. It is adjustable to different speeds by means of a nut workon a thread on the valve-stem. The remarks that have been made with regard to governor of the Brotherhood engine apply as well to this, viz, that there must be variation in the speed to produce a change in the opening of the governor valve, nd the greater must this variation be the greater the range of pressure which the ngine is designed to work. The governor of this engine is probably as effective in reserving uniformity of revolution as any of its class. With 60 pounds boiler pressure, the engine running at 600 revolutions, the speed momentarily increased less than 00 turns, when the whole load was thrown off by suddenly breaking the lamp circuit, a permanent increase of speed of about 25 revolutions per minute being recorded. he governor is set for about 600 revolutions (with 60 pounds of steam), it being found hat at this speed the dynamo supplies as great a current as can be utilized in the amps.

The engine is very simple in construction, the parts are readily accessible, and it equires very little attention in running. Including the oil-feed in the steam supplyipe it is practically self-lubricating, and no difficulty was experienced at any time y the overheating of any part. It drives the dynamo at a speed of 600 to 650 revotions, with two lamps and the necessary lead in circuit with a minimum boiler press of 55 pounds. The engine being located at a considerable distance from the oiler, the pressure at the engine required to drive the dynamo at the proper speed is robably somewhat less.

The engine runs, when loaded, with comparatively little vibration up to 600 turns. bove this speed the vibration is more marked, but even at 800 revolutions is not such to endanger any part of the apparatus. The bed-plate of the engine is bolted to floor of the dynamo room, which is of 2-inch pine covered by ordinary tongued grooved flooring without any stiffening or support. The dynamo and engine are ated to the same bed-plate.

The total space occupied by the engine and dynamo, the linear dimensions being ken to include all projections from both, is 7′ 3½″ in length, 2′ 6¼″ in width, and 4′ high. The bed-plate is 6′ 6″ by 2′ 2″.

THE LAMPS AND PROJECTORS.

The lamps are automatic focussing lamps. The carriers of the carbons are attached brass rods, which are joined together by means of levers so proportioned as to give each its proper motion. The establishment of the arc is effected by the tilting of flat ring around the rod carrying the positive carbon, tilting being produced by the otion of a tilting rod attached to a lever on the armature of the controlling magnet. e controlling magnet is double and is differentially wound, the coarse coils, which e in multiple arc in the main circuit, having a joint resistance of 0.01 ohm; the fine ils, which are in series and joined as a shunt to the lamp terminals, having a reance of 180 ohms. A dash pot, containing glycerine, is attached to the rod operat-

ing the lever arrangement controlling the arc; another is placed on the armature of the controlling magnet; the two dash pots prevent any violent oscillations of the mechanism.

The carbons are coated with copper, the diameter of the positive carbon being one inch, that of the negative three-quarters of an inch. The positive carbon carrier is adjustable, so that the carbons may be arranged "in line" (*i. e.*, with their axes in the same line), or the upper carbon may be displaced so that the crater occupies an angular position on its end. The height of the lamp is 26¼ inches, and its base occupies a superficial area of 12 by 13 inches.

The projectors are shallow parabolic mirrors of silvered copper, 26 inches diameter and 4¼ inches focal length. They are supported by a brass stud soldered to the back of the mirror, which fits in a socket on the front of the lamp. In our experiments a glass screen was placed in front of the lamp to protect it from the wind, but no other appliance was made use of.

The leading wires used with the Brush lamps were such as are on hand at the station, no special wires being furnished.

The following shows in detail the experiments which have been carried out with the various apparatus on which the conclusions contained in this report are based.

The Brush dynamo, driven by the Westinghouse engine, was 1, with two automatic (Brush) lamps in circuit; 2, with two hand-regulating (Mangin) lamps in circuit; 3, with one hand lamp (Mangin) and an added resistance equivalent to another lamp in circuit; 4, with one automatic lamp (Brush) and an added resistance in circuit; 5, with one automatic lamp (Brush) inclined at the same angle as the Mangin lamp and an added resistance in circuit.

The same dynamo belted to the main engine was run, 1, with two automatic (Brush) lamps in circuit; 2, with two hand lamps (Mangin) in circuit.

The Gramme dynamos, driven by the Brotherhood engine, were run, 1, with each dynamo supplying its own lamp; 2, with both dynamos supplying a single lamp.

Measurements of the current, the electro-motive force at the terminals of the machine, and of the intensity of the light under these varying conditions, were made and the results are included in this report.

In addition, the dynamos were run for several hours each for the purpose of determining the facility of handling, the requirements as to attention, and the heating of the dynamos and engines.

The range of the 60-centimeter projector, with a single dynamo feeding the lamp and with two dynamos feeding the lamp, was compared with the Brush automatic lamp in front of its parabolic mirror, with the Siemens holophote in front of a Brush automatic lamp, and with the 90-centimeter projector. These comparisons were made on several favorable evenings.

CONCLUSIONS.

The following are the conclusions of the Board as to the comparative merits of the various parts of the apparatus:

The engines are about equally adapted to running directly a dynamo machine at a speed of 650 revolutions. The Brotherhood engine has the advantage of running at a lower steam-pressure than would be required by the Westinghouse engine to do the same work. This is undoubtedly a very important point in connection with the use of the engine on board ships where the boilers deteriorate during a cruise. While the Westinghouse engine may be adjusted to run with a lower steam-pressure than was used in our experiments, it is doubtful whether the pressure could be reduced to the limit that would be required in our vessels of war after a prolonged cruise.

On the other hand, the Westinghouse engine has the merit of greater accessibility of the working parts, especially of the valve. To get at the valve of the Brotherhood engine requires the moving of one of the dynamos before the valve chest can be removed. This objection, however, would not obtain if the engine were driving a single dynamo. The valve of the Westinghouse engine can be removed by disconnecting it from the eccentric and removing the bonnet to the valve chamber.

The dynamos are apparently equally adapted to the work required of each. We are of the opinion, however, that two search-lights should not be run in series in the same circuit, nor is the arrangement of driving two dynamos by the same motor desirable. Each search-light with its dynamo and engine should be entirely independent of the other, so that in case of the failure of one lamp, or one dynamo, or one engine, the service of the other should not be lost. When two lamps are in the same circuit, not only will the destruction of one lamp entail the extinction of the other, but any temporary fluctuation, either from careless attendance, if hand lamps are used, or from failure of the automatic lamps to operate properly, will injuriously affect the other lamp. The steadiness of the Brush lamp, when but one lamp was in circuit, was considerably increased.

We regard the automatic lamp as unsuited to the general purpose of a search-light. The only argument urged in their favor is that they require no direct personal atten-

tion. Their disadvantages are the difficulty of adjusting the arc in the focus of the reflector, the utter impossibility of maintaining the arc in the focus without personal attention, and their liability to the derangement of their mechanism, which would be aggravated in use on shipboard. In the Brush lamps and reflectors the carbons must first be adjusted by guess. If, after starting, the arc is found to be out of position, the light must be extinguished and time allowed for the mechanism to cool down before any further adjustment can be effected. Even after the position of the arc is properly determined, the arc will not remain in position on account of inequalities in the carbons. In addition, great unsteadiness of the light arises from the continual shifting of the arc from side to side of the carbon, which is almost, if not entirely, prevented in the hand lamps This irregularity arises both from the want of homogeneity in the carbon points and the large diameter of the carbons required to carry heavy currents.

The Mangin lamps are simple in construction, are readily manipulated after slight experience, and maintain very steady arcs.

The Mangin projectors are superior in all respects to any which we have tried, or of which we have obtained any reliable data. We have already referred to the difficulty, if not impossibility, of constructing a parabolic reflector of perfect form. The Fresnel lens of the Siemens holophote is superior to a metallic parabolic reflector, but in this the loss of light by absorption is very great. The Mangin mirror is, in all essential respects, the equivalent of a parabolic reflector and is probably the most perfect reflector in existence. The projectors are easily manipulated, the parts being not liable to derangement. They are complete in all respects, permitting the observation of the arc and its adjustment at all times without opening the projector door. The fact that they are non-automatic is not a disadvantage. If it be considered necessary to sweep the light about, this operation can better be performed by hand. The only advantage to be derived from an automatically revolved projector is that the person of the operator is not exposed; but if, as would most likely be the case, the light be desired in a particular direction, an operator must be at hand to direct it. We consider that the effective operation of a search-light, both of the projector and of the lamp, can only be performed by hand.

The experiments made to determine the range of the different lights were unsatisfactory. With the exception of the 90-centimeter projector (which was on the wharf elevated 10 feet above the level of the water), the projectors were set up in the second story of the machine shop. From this position a long range was available, but it was found that the illumination of the intervening objects on the land prevented a proper appreciation of the light or the perception of objects at great distances on the water. All objects within a range of 2,000 yards, where no other large objects intervened, were made visible by the 60-centimeter projectors, and to a less degree by the Brush reflectors. A small building of dark-gray color on Coaster's Harbor Island at a distance of 2,500 yards was distinctly visible with the Mangin projectors, and could be seen at favorable intervals with the Brush reflectors. The angular breadth of the area illuminated by the Mangin projector was estimated at about 2° without the diverging lens and 15° with the diverging lens in use. The breadth of the area covered by the beam from the Brush reflector was about the same as that from the Mangin projector with the diverging lens, but with the latter the illumination of the surrounding objects was not increased in proportion to the increase of the area of illumination at the point desired. A red buoy in the water at a distance of 3,650 yards could not be distinguished with any projector, the breakwater and the light-house lying nearly in range with the buoy. The superior steadiness of the beam of light from the Mangin projector was marked.

The increased illumination of distant objects when both the Gramme machines are supplying one lamp was very noticeable. Every detail of the shore line of Coaster's Harbor Island (at a distance of 2,000 to 2,300 yards) was brought out by the projector. We are of the opinion that a more powerful dynamo for each lamp is very desirable, thus avoiding the use of the commutator for putting both machines on the same lamp. This would necessitate a separate engine for each dynamo, but, as has been stated, we consider that such an arrangement would be superior to the present one. The two dynamos and engines would require but little more space than that required for the present arrangement: the same attendant could attend both engines and dynamos without difficulty, and one or both dynamos could be operated as required.

Appended are the results of the measurements made to determine the illuminating power of the different lamps. We would point out the great difficulty of measurements of this character; that is, the comparison of powerful lights with a comparatively insignificant standard. We do not consider the light measurements as accurately representing the illuminating power of the lights, but as a means of comparing the various sources among themselves they possess some value. The standard of light was the carcel lamp, which is rated at 9.5 candles. The photometer was of the Ritchie form. The currents in the circuit were measured by one of Ayston & Perry's

ammeters, shunted, the constant of the instrument and the multiplying power of the shunt having been determined frequently during the experiments. The differences of potential were measured by a voltameter of Ayston & Perry, having a resistance of 400 ohms, an additional resistance of 800 ohms being interposed in the circuit.

Very respectfully,

THEO. F. JEWELL,
Lieutenant-Commander.
W. MAYNARD,
Lieutenant.

Before signing this report I wish to present several statements and opinions different from those found in the body of the report, as follows:

For lines 20–22, page 22, I would substitute: for the purpose of connecting in arc the field coils of. Page 23, lines 9–24: To this statement I would add that in subsequent trials of the commutator, made for the purpose of provoking reversals, none occurred, also that no special experiments were made either to discover the cause of the reversals or their relative frequency. Page 30: Through this machine fairly fills the conditions under which it was constructed, the conditions imposed required too great differences in potential for the best results in search lights. The energy developed in the external circuit is not a proper criterion either of the fitness of the dynamo or the conditions of its workings. Page 41, lines 24, 25, I would omit. Page 42: It does not seem to me either necessary or desirable that a separate motor should be provided for each light, though it is necessary that two lights should not be included in the same circuit, either in series or in arc. Page 46, line 20, to page 47, line 6: As already stated, I do not agree to this conclusion.

If a ship of a certain class is fitted with two search lights of appropriate power, each light having its own dynamo, both dynamos being driven by the same motor, they will always revolve at the same speed, and may therefore be coupled in arc very much as two voltaic batteries having the same electro-motive force may be so coupled. The commutator is a simple device for connecting both the armatures and the field coils of the dynamos in arc, and thus, by practically combining both machines in one and using all the available current in one lamp, we may obtain, on special occasions, one light of more than double the power of the normal lights. The proposition to increase each normal light to this power, having a separate motor and dynamos for each, means a considerable increase in weight (over 100 per cent.) and in floor space, taking into account the clear space required for accessibility, &c. Having these very powerful lights, it were possible to combine them in one twice as powerful, would this again be an argument for increasing the power of each in order to do away with the commutator? To economize space it might be advisable to have for both lights but one motor and but one multipolar dynamo compound wound with a separate circuit for each light, but so arranged that on special occasions the currents of both circuits could be used in producing one very powerful light. Ships having dynamos for general lighting should have them duplicates of the dynamos for search lights, so that they could take their places temporarily.

In examining the tabulated data it is apparent that, because of the very anomalous variations in the differences of the introdependent functions, it is possible to draw from them only the most general conclusions.

The Brush dynamo appears to have given less candle-power per horse-power (in circuit) than the Gramme in each series of experiments (taking the mean of each series). The best results with the Brush were apparently obtained with lower speeds and less differences of potential than those named in the conditions imposed in its construction. It is worthy of note that the Brush dynamo gave a more regular record when it was driven by belt from the line shafting of the shop, driven by the main shop engine. (See pages 49, 51, 54.)

Respectfully submitted.

T. C. McLEAN,
Lieutenant, U. S. N.

Capt. THOMAS O. SELFRIDGE,
In charge of Station.

Number.	Boiler pressure.	Revolutions of dynamo.	Total external resistance.	Current.	Difference of potential at terminals.	circuit. Leads.	Arcs.	Total.	Candle-power.	Remarks.
			$\frac{E}{S}$	S.	E.	$r.S^2$ +.00134	$S(E-rS)$ +.00134	E.S. +.00134		
	Lbs.		*Ohms.*	*Ampères.*	*Volts.*					
1	59	624	2.63	49.4	130	0.52	8.09	8.61	15,130	Two Brush automatic lamps, upper carbon displaced to rear.
2	60	624	2.74	47.5	130	0.48	7.79	8.27	18,390	
3	59	610	2.84	47.5	135	0.48	8.11	8.59	11,170	*Ohms.*
4	60	615	2.67	47.5	127	0.48	7.60	8.08	11,170	Resistance of machine 0.62
5	60	610	2.14	53.2	114	0.61	7.52	8.13	18,390	Resistance of leads 0.075
6	60	632	2.50	55.2	138	0.65	9.56	10.21	15,130	Resistance of lamps 0.032
7	60	633	2.38	51.3	122	0.56	7.83	8.39	8,270	Resistance of ammeter 0.053
8	60	641	2.44	53.2	130	0.61	8.66	9.27	8,270	
9	60	590	2.74	45.6	125	0.45	7.19	7.64	13,810	Total external resistance, exclusive of arcs . $r = 0.16$
10	60	600	2.63	47.5	125	0.48	7.48	7.96	13,810	
Mean	59.8	618	2.57	49.8	128	0.53	7.98	8.51	13,354	

MARCH 29, 1884.—BRUSH MACHINE No. 7, WESTINGHOUSE ENGINE.

Number.	Boiler pressure.	Revolutions of dynamo.	Total external resistance.	Current.	Difference of potential at terminals.	Leads.	Arcs.	Total.	Candle-power.	Remarks.
1	60	510	2.6	47.5	125	0.39	7.57	7.96	14,450	Two hand-lamps, Maugin, with Brush carbons.
2	60	530	1.5	51.3	75	0.45	4.71	5.16	13,810	Resistance of leads (including ammeter), $r = 0.128$ ohms.
3	60	512	1.7	52.1	91	0.47	5.88	6.35	20,290	
4	60	495	1.6	54	86	0.50	5.72	6.22	24,160	
5	60	498	1.6	55.2	88	0.52	5.99	6.51	20,290	
6	60	500	1.4	55.2	75	0.52	5.03	5.55	14,450	
7	60	490	1.5	53.2	79	0.49	5.14	5.63	18,390	
8	58	516	1.4	57.8	81	0.57	5.70	6.27	25,630	
9	60	550	1.4	60.9	84	0.64	6.21	6.85	27,240	
10	62	603	1.4	67.4	96	0.78	7.89	8.67	29,000	
Mean	60	520	1.6	55.5	88	0.53	5.96	6.52	20,770	

MARCH 31, 1884.—BRUSH MACHINE No. 7, WESTINGHOUSE ENGINE.

Number.	Boiler pressure.	Revolutions of dynamo.	Total external resistance.	Current.	Difference of potential at terminals.	Horse-power developed in external circuit. Leads.	Arcs.	Total.	Candle-power.	Remarks.
			$\frac{E}{S}$	S.	E.	$r.S^2$ $+.0134$	$S(E-rS)$ $+.0134$	E.S. $+.00134$		
	Lbs.		*Ohms.*	*Ampères.*	*Volts.*					
1	62	650	2.5	52.1	130	4.89	4.19	9.08	19,370	One Brush automatic lamp in circuit with an added resistance. Lamp inclined at an angle equal to the inclination of the Mangin lamp.
2	62	650	2.5	50.3	125	4.56	3.87	8.43	22,810	
3	63	655	2.3	52.0	119	4.87	3.42	8.29	14,450	
4	63	635	2.4	50.6	122	4.61	3.66	8.27	15,810	Resistance of leads .... 0.075 ohms.
5	64	635	2.3	52.1	122	4.89	3.63	8.52	16,700	Resistance of lamp .... .016 ohms.
6	65	645	2.4	52.0	125	4.15	4.56	8.71	18,390	Resistance of ammeter .... .053 ohms.
7	65	645	2.6	48.3	125	3.58	4.51	8.09	19,370	Resistance added .... 1.200 ohms.
8	64	645	2.5	50.3	125	3.88	4.55	8.43	12,110	
9	65	630	2.4	52.1	127	4.16	4.71	8.87	12,130	$r=1.344$ ohms.
10	60	625	2.4	49.4	119	3.74	4.14	7.88	20,420	
Mean	63.3	641.5	2.43	50.9	123.9	4.33	4.12	8.46	17,156	After the first five observations the interpolated resistance was reduced to 1 ohm, making $r=1.144$.

MARCH 31, 1884.—BRUSH MACHINE No. 7, WESTINGHOUSE ENGINE.

1	60	560	2.6	49.4	127	4.34	4.07	8.41	18,890	One hand-regulator (Mangin) lamp in circuit, with added resistance.
2	60	568	2.4	51.3	122	4.68	3.71	8.39	24,160	
3	60	548	2.3	47.9	109	4.08	2.92	7.00	14,450	Resistance of leads 0.075
4	60	532	2.5	45.6	112	3.70	3.14	6.84	15,810	Resistance of ammeter .... .053
5	60	530	2.6	43.7	112	3.40	3.16	6.56	21,630	Resistance added 1.2
6	60	532	2.9	39.9	114	2.83	3.27	6.10	22,810	
7	63	530	2.4	47.5	114	4.02	3.24	7.26	12,130	$r=1.328$
8	61	520	2.7	41.7	112	3.09	3.17	6.26	21,630	
9	60	540	2.3	45.6	106	3.70	2.78	6.48	16,700	
10	65	560	2.2	51.3	114	4.68	3.16	7.84	24,160	

1	590	2.2	59.4	130	0.83	9.52	10.85	11,380	Two Brush automatic lamps in circuit.
2	600	2.4	54.4	130	0.69	8.79	9.48	12,680	Resistance of leads 0.09
3	610	2.5	51.8	130	0.63	8.89	9.02	13,800	Resistance of lamps 0.032
4	600	2.5	53.3	135	0.67	8.99	9.66	14,470	Resistance of ammeter 0.053
Mean	600	2.4	54.7	131.3	0.71	8.92	9.63	13,080	$r=$ 0.175
									Experiments suspended on account of slipping of belt.

MAY 20, 1884.—BRUSH MACHINE No. 7, BELTED TO MAIN (SHOP) ENGINE.

1	620	2.2	55.6	122	0.73	8.36	9.09	×21,580	Two Brush automatic lamps in circuit.
2	650	2.3	54.4	127	0.69	8.57	9.26	×24,090	Resistance of leads, &c .... 0.175 ohms.
3	640	2.3	57.2	133	0.77	9.42	10.19	×26,400	The light measurements marked × were made when the arc was at its brightest. The others were made at reasonably favorable times.
4	630	2.3	57.2	130	0.77	9.19	9.96	×31,970	Average C. P., first five 28,696
5	660	1.9	64.5	122	0.98	9.57	10.55	×39,440	Average C. P., second five 17,306
6	650	2.3	59.4	135	0.83	9.91	10.74	14,450	
7	650	2.9	46.7	133	0.51	7.81	8.32	15,130	
8	650	2.1	63.5	133	0.95	10.37	11.32	19,650	
9	650	2.1	66.0	140	1.02	11.36	12.38	18,820	
10	650	1.9	67.1	130	1.06	10.63	11.69	18,480	
Mean	645	2.2	59.2	130.5	0.83	9.52	10.35	23,000	

MAY 20, 1884.—BRUSH MACHINE No. 7, BELTED TO MAIN ENGINE.

1	650	1.7	68.3	114	0.89	9.54	10.43	31,490	Two Mangin hand lamps in circuit.
2	630	1.5	65.8	117	0.83	9.49	10.32	30,740	Resistance of leads 0.09
3	630	1.8	65.8	117	0.83	9.49	10.32	31,490	Resistance of ammeter 0.053
4	635	1.8	64.5	117	0.80	9.31	10.11	29,320	
5	630	1.8	66.6	117	0.85	9.59	10.44	33,070	$r=$ 0.143
6	640	1.9	65.0	120	0.81	9.64	10.45	29,320	
7	645	2.1	60.7	125	0.71	9.46	10.17	22,980	
Mean	637	1.84	65.2	118	0.82	9.50	10.32	29,773	

APRIL 12, 1884—GRAMME MACHINE, BROTHERHOOD ENGINE.

Number.	Boiler pressure.	Revolutions of dynamo.	Total external resistance.	Current.	Difference of potential at terminals.	Horse-power developed in external circuit.			Candle-power.	Remarks.
						Leads.	Arcs.	Total.		
			$\frac{E}{S}$	S.	E.	$\frac{r.S^2}{+.00134}$	$\frac{S(E-rS)}{+.00134}$	$\frac{E.S.}{+.00134}$		
	Lbs.		*Ohms.*	*Ampères.*	*Volts.*					
1	44	660	1.49	39.2	58.5	0.34	2.73	3.07	24,550	Both machines supplying each one lamp. $r = 0.163$.
2	48	685	1.28	43.9	56.0	0.42	2.87	3.29	19,150	Length of arc about 0.2 inch.
3	53	675	1.11	47.4	52.5	0.49	2.84	3.33	19,790	Average E. M. F. of dynamo 87.6 volts.
4	55	655	1.22	43.9	53.5	0.42	2.73	3.15	14,030	
5	55	700	1.00	46.2	46.0	0.47	2.38	2.85	25,530	
6	50	630	0.99	43.9	43.5	0.42	2.14	2.56	18,820	
7	50	665	1.10	43.9	48.5	0.42	2.43	2.85	22,800	
8	49	685	1.17	39.2	46.0	0.34	2.08	2.42	20,480	
9	49	675	1.14	40.4	46.0	0.36	2.13	2.49	17,930	
10	49	615	0.78	46.2	36.0	0.47	1.76	2.23	20,480	
Mean	50.2	665	1.13	43.4	48.7	0.41	2.41	2.82	20,350	

APRIL 12, 1884—GRAMME MACHINE, BROTHERHOOD ENGINE.

Number.	Boiler pressure.	Revolutions of dynamo.	Total external resistance.	Current.	Difference of potential at terminals.	Horse-power, leads.	Horse-power, arcs.	Horse-power, total.	Candle-power.	Remarks.
1	48	650	0.88	66.3	58.5	0.96	4.24	5.20	47,600	Two machines coupled parallel on one hand lamp.
2	48	665	0.94	65.1	61.0	0.93	4.39	5.32	29,900	Resistance of leads........................ 0.11
3	49	685	1.01	58.0	58.5	0.74	3.81	4.55	50,200	Resistance of ammeter.................. 0.053
4	50	660	1.18	58.0	68.5	0.74	4.58	5.32	39,000	
5	52	680	1.34	51.0	68.5	0.57	4.11	4.68	47,600	$r = 0.163$
6	52	670	1.14	55.7	63.5	0.68	4.06	4.74	39,000	Average E. M. F. developed by dynamo 87.0 volts. Length of arc
7	50	645	1.29	51.0	66.0	0.57	3.94	4.51	×66,700	about 0.4 inch.
8	50	655	1.17	52.1	61.0	0.59	3.67	4.26	×75,800	The measurements marked × are evidently erroneous. The observer had been adjusting the arc of the measured lamp for some
9	50	650	0.80	60.4	48.5	0.80	3.13	3.93	×75,800	time, and his eyes had probably become fatigued.
10	50	650	0.95	60.4	57.5	0.80	3.84	4.64	×68,800	The mean of the other six measurements is given in the column "Candle Power."
Mean	49.9	661	1.07	57.8	61.2	0.74	3.98	4.72	42,200	The observer of the data marked × thinks that they are erroneous, and

ı obedience to your order, I have the honor to submit the following report ternational Electrical Exhibition recently held at Philadelphia, Pa.
hibit of primary batteries suitable for use on shipboard was considerable, atteries shown seemed to possess any superiority over the Le Clanché for work. Some were more simple and others more powerful, but gain in sim- each case was at the cost of efficiency, and increase in power in each case ı than compensated by loss of simplicity.
ndary batteries the display was small, and though careful tests of efficiency, y, &c., have been made, the results have not as yet been made public. ıs little indication, however, that storage batteries are so far perfected that ope for much usefulness for them for ship lighting. A small storage bat- shown, however, which would probably be very useful in electric gun firing rpedo firing from boats. It is the invention of E. E. and E. T. Starr, and is so l light that it could be easily worn at the belt like a primer box. One cell about 2 inches square by one-half an inch thick, and weighs but a few One would be sufficient for gun firing, two for torpedo firing. Trial of these :fully recommended, as the advantages to be derived from them, if found ›ry, are so very great. In case both of the electric gun circuits are shot ıction, the gun captains could simply connect the gun wires to a little stor- ›ry at the belt and fire the guns by electricity until the breaks in the circuit ›e bridged over. For torpedo work in boats their lightness would be very ;eous. An electro-magnet of considerable resistance with an ordinary arma- .ld act as a circuit tester; the firing key, short-circuiting this resistance ›ssed, would throw the full current through the torpedo. The question of ıy and retentivity is of slight importance, as the battery could be charged ly by putting it in circuit with an Edison lamp for fifteen minutes, the light ıp not being appreciably diminished thereby, and the amount of energy thus the battery being probably sufficient for a day's firing, as, it should be re- d, the quantity of electricity necessary for firing a gun is very minute. Two :ells were used to feed a small incandescent lamp worn as a breast-pin, the g carried in the pocket. The light given off was a little less than one candle Such a contrivance might not be inconvenient for use in the holds, maga-

he 90-centimeter Mangin projector belonging to the Bureau hoisted into the tower of the exhibition building, whence it could throw its beam over the art of the city of Philadelphia. It was fed by two Grammes coupled in par- run by a Brotherhood engine on the same bed-plate. The distance between ›tor and the Grammes was about a hundred yards, as the wires led. The ued very well, the 18^{mm} carbons being more satisfactory than the 25^{mm} car- ıe Grammes and Brotherhood did not run as smoothly as could be wished, vas due partly to the fact that the foundation was of wood. The governor otherhood did not act very well, and has been improved in recent Brother- ines. It would probably be well to attack the trouble at its root, and wind mes so that their field-magnets would not demagnetize if the circuit breaks. e various means of securing constant potential is recommended, as, if wound ınt current, the sudden access of current through the shunt on breaking the circuit would injure the insulation. A series dynamo with a long shunt run- ı terminal to terminal would probably be the best thing. In case the external as broken, as happens occasionally with hand-fed lamps and large carbons, nt through the shunt would be constant from the construction of the machine. ency to race would therefore be very much less than in a series wound ma-

ne of the 60-centimeter projectors occasionally with a Ball machine. The .tion of the shade between the light and the mirror gives an excellent means ing by flashes, but would probably be inferior for ship use to the method Lieut. Com'd'r Bradford on board the Trenton, in which two incandescent ıced one above the other, and controlled by two keys, were used. By press- ey two lights were shown; by pressing the other, one light. A better means signaling has not yet been devised. In this connection, the attention of the ı respectfully called to the successful experiments of the Russians at Cron- which a captive balloon was used to hold incandescent lights at a consider- ht, the current being operated by a man on the ground.
nstruction of the 60-centimeter projector seems more complicated than neces- the weight greater. The possibility is suggested of making the pedestal in of a shield. The wires could come up behind it and connect direct to the lamp. of the lamp could be flanged out to a short distance and the flange (of steel) with peep holes. The man working the lamp is in a very exposed position, ›ans are taken to promote his safety, he can manage the light with coolness.

At a distance of one mile and a half from the 90-centimeter projector were the city buildings; and numerous spires and other prominent objects were in sight at various distances. On clear dark nights, the public buildings were very plainly visible to the naked eye of a man standing at the projector. But I found that it was impossible for the eye to detect objects even much nearer if the lamp were swung rapidly around; unless, in fact, it were turned very slowly. This has direct bearing on the use of projectors in detecting the approach of fast torpedo boats, and indicates that more than one projector on one side of a ship is necessary. The number of projectors on each side should be such that the area swept by each shall be so small that the light may be revolved with the necessary slowness, and yet that so short an interval shall elapse between the successive returns of the beam to a certain point, that in that interval a fast torpedo boat could approach only a short distance. It may be found that the number of projectors should be increased, even if the intensity of each be diminished. An additional reason for this lies in the fact that an electric light in a projector may be extinguished by a Gatling in a torpedo boat. The greater the number of lights the less the loss if one be extinguished. Another reason lies in the fact that torpedo boats will never attack a ship singly, but will attack in concert a number, say twelve, approaching simultaneously from different points. If an insufficient number of projectors be on board, and even if each projector be able to pick up one torpedo boat, each projector will of course keep its light on the torpedo boat it has picked up, and the other boats can approach in complete darkness, and take up convenient positions near the ship, from which to discharge their Whiteheads.

With a view to seeing how the light would look to an approaching enemy, I went to different parts of the city and observed it from the tops of hotels and other elevated places. When the ray was turned directly on me when I was one mile and a half distant, I read the fine print of a railroad time table held at arm's length. Yet I could look full at the light without inconvenience. While at this distance and when the lamp was revolved, elevated, and depressed, &c., the path of the beam through the atmosphere could be seen with very great distinctness. Even when the beam was thrown at right angles to the line between me and the lamp, it could be very plainly seen, and could be followed to the distance of about a mile.

With a view to getting an idea as to the effect of the beam upon an enemy near at hand, I frequently turned it on people in the street below, who were about 100 feet distant. Some looked directly at the light for some seconds, thus showing that the notion that an enemy cannot fire at an electric light is a mistake.

There were no dynamos shown at the exhibition as intended for search lights. Yet as the requirements for search lights are not difficult to meet, there would be no difficulty in getting a suitable dynamo from any of the leading electrical companies. The Brush "compound dynamo" would seem to possess some advantages over the others, from the fact that two similar ones could be used—one for the search lights, the other for the incandescent. Then if the incandescent and search lamps were made to work at the same potential—a thing easily done—one dynamo could be used to replace the other if broken down, as it would very seldom happen that all the search lights and all the incandescent would be required at the same time.

There were a number of systems shown all applicable for incandescent lighting. A comparison between them would be premature, from the fact that the report of the Board of Examiners of the Exhibition has not yet been published, and because the three leading systems will shortly begin practical trial on board three of the new cruisers.

The display of conductors was considerable. Obviously the best conductors for shipboard are those that are covered with lead. It is understood that practical experiments in Germany with underground conductors have shown that the most durable thing is a lead-coated conductor, covered with braiding.

The exhibit of telephones of various kinds was very complete, and suggested the advisability of devising means for adapting the telephone to naval purposes. In this connection it may be stated that I had a telephone running from the Grammes up into the tower, where the 90-centimeter projector was situated, a distance of about 100 yards as the wire led. As the building was a temporary affair, and built of wood, and was full of machinery in motion, the vibration of the structure was very great—very much greater than any vibration on board ship, except at the instant of firing; yet even when the vibration was at its greatest, there was little difficulty in communicating between the two ends of the line. But since the ordinary microphone transmitter is a very delicate thing for use on shipboard, I experimented with a view to using magneto-transmitters instead. I found that the receivers, when used as transmitters, were almost entirely unaffected by the shaking of the building, and that it was perfectly possible to carry on conversation between the two ends of the line, using the receivers alternately as transmitters and receivers, even when the building was shaking greatly. The possibility of using the magneto-telephone on shipboard is thus clearly shown, especially since the Bell Company make regular magneto transmitters which are more efficient than receivers used as transmitters. It is

that a telephone line could be run on board ship from the er's office, which would have say ten stations in series, each with one receiver and one magneto transmitter. A call signal sed, so that any person—the master-at-arms for instance—could of time effected by such an arrangement would be great.

was shown suitable for communication between moving ob- two ships, two boats, a ship and a boat, &c. The insulating wire was el and was in contact with its axle, so that the circuit remained un- wire paid out, as in the ordinary torpedo reel. The uses to which such or a somewhat similar one, could be put, are evidently numerous. The nd light. One very obvious use would be in communicating with land- and picket boats. There would be no practical difficulty in putting the telephone into a boat, and letting the wire pay out as the boat advanced, up when the boat returned. A signal boy could keep the wire clear swung.

microphone transmitter, if used on board ship, would undoubtedly re than the magneto, but attention is respectfully called to the obvi- s to be gained. One of the most important uses would doubtless be in mmunication with a landing party on shore. Information could be party on shore or by scouts, instructions could be asked and received, or extra ammunition called for, with great despatch, at a time when might be necessary.

of a fleet at anchor, each ship could run her wire to the flagship. Com- etween the ships could thus be made much more quickly and accurately nal flags, "wigwags," &c.

g place for the navy boats at any of the cities on this coast and in some tries could be permanently connected with the central telephone ex- y ship anchoring in the harbor could send her wire ashore at once, and it at the landing. She would thus be able to hold instant communication navy-yard, naval hospital, police headquarters, the most important business . The convenience of such an arrangement would be very great. In case were suddenly ordered to sea, much time in preparation would be nts could instantly be made by telephone for the delivery of the

to keep the wire clear as the ship swung, it would probably be best to board over the bow, so that the ship could swing around it, some spare coiled on a reel in the circuit, in order to pay out in case the wire fouled. the wire should break, it could be hauled in, spliced, and run out again minutes. A signal boy could be detailed to tend it.

connection attention is respectfully called to the scheme for electric signal- t wires between ships, proposed by Prof. A. Graham Bell, and some modifi- it proposed by other scientists. By these plans a strong generator of elec- ship is connected to one earth-plate at the bow and to another which ards astern, by an insulated wire. On another ship is a suitable cur- connected to two similar earth-plates. Part of the current will be com- ough this indicator, so that preconcerted makes and breaks made on board hip can be read on board the second. If the current be alternating—such ed by an alternate-current machine—the makes and breaks can be detected he second ship by a receiving telephone. Professor Bell stated at the meet- American Association for the Advancement of Science that he had held on by this means between boats separated a considerable distance. It also recollected that communication was held for some time by similar means n the Isle of Wight and the mainland, when the regular cable was broken. The of water opposite one of the earth-plates was 1 mile, opposite the other 6 miles. suitable experiments show that such a plan can be made practicable for gen- its value would be very great for communicating between ships in fogs, sig- etween ships of a fleet at sea, &c. It would seem that the possible advan- such as at least to merit trial.

cellent velocimeter was shown at the exhibition, in which the vibrations of a fork made and broke a circuit in which was placed a stylus pressing on a strip cally prepared paper. This paper was drawn along under the stylus by reel- y hand from one reel to another, uniform speed not being required. The stylus ormally short-circuited by a wire which was broken when the projectile left the . The circuit through the stylus then being complete a series of dots appeared paper, one dot for each make and break. In the particular instrument shown, mber per second was 100. When the projectile reached the distance over which of flight was to be measured, it broke the circuit through the stylus. The of dots made on the paper was the number of hundredths of seconds of flight. wing the paper along at a convenient speed, the distance between the dots could be divided by ten. Thus the time could be told to the thousandth of a sec-

ond, and there were no corrections to be made for magnetization or demagnetiz The instrument is the invention of Mr. F. W. Cushing.

The display of electro-motors at the exhibition was very fair, and showed th sibility of their coming into extended use, as soon as the call for electric light motors is great enough to pay for running the necessary circuits. The motors shown in operation every evening running lathes, saws, looms, ventilators, &c. tests of the Board of Examiners with reference to their return of energy fo energy of the prime mover have not yet been made public; but enough is know make it safe to say, that when a number of small motors are run by a large dy turned by an economical stationary engine at a central station, we can expe much economy as from the same number of isolated small steam-engines. It borne in mind also, that the use of a small motor does not necessitate a boil engine with attendant noise and dirt.

There were no electric steering apparatus shown at the Exhibition, but th sibility of simply gearing an electro-motor to the shaft of the ordinary steering is apparent. No change whatever would be necessary and the wheel could be by hand or by electricity at will; by hand in case the electrical arrangement g of order. The addition also of another dynamo to the electric plant now sup would be attended with numerous advantages. We would then have electric m at hand, ready to start at a second's notice at the touching of a key. These m could be used for steering, as indicated above, for hoisting projectiles and po from the magazines, for working the yard and stay, for hoisting articles from hold, &c., with more despatch and less noise than is now possible. An electro-n put on the axle of a machine-gun also would enable the gun to be fired with speed and accuracy than is now possible. And in almost any case in which an ele motor is geared to a shaft, the shaft itself is not changed; so that accident to motor will not prevent the shaft being revolved by hand.

A convenient apparatus was shown at the Exhibition, which consisted simply indicator in the pilot-house so connected with the reversing mechanism in the en room that the officer of the deck could tell at a glance whether the engines were ing or going ahead or were stopped.

Another convenient use for electricity on board ship may be suggested, in w the ship's bell is replaced by a large electric bell. This could be struck fron quarter-deck without sending away the messenger. The boats could be sim called away, the steam launch being called by striking say the letter *a*-2-2. calls to quarters, meals, &c., could be similarly made.

As the possibility of successfully adapting electricity to ship life depends gr upon the proper arrangement of the circuits, the importance is manifest of double circuits, each one of enough wire to carry the full current necessary, but one ordinarily carrying only half the current. In other words, the mains shou led fore and aft on each side, each main being large enough to carry the curre both sides, both mains being connected across the deck. In case one main i away or otherwise broken, no part of the electrical apparatus will be thrown c action, because the full current now goes through the other main. The broken can now be repaired. For doing this quickly, I would suggest that short leng wire be kept on hand with spring clamps on the ends. Any break can, with these, be quickly bridged over.

I have the honor to be, sir, very respectfully,

B. A. FISKE,
Lieutenant, United States N

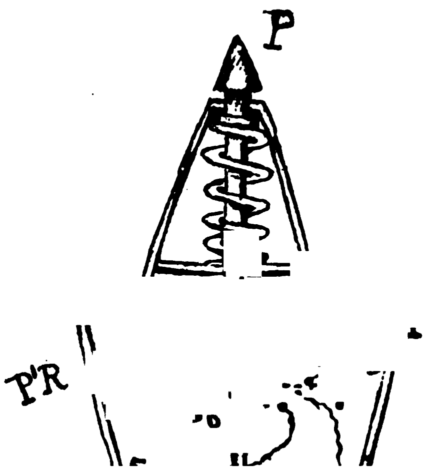
Capt. MONTGOMERY SICARD, U. S. N.,
Chief of Bureau of Ordnance.

ELECTRICAL TORPEDO-BOAT.

WASHINGTON, *October* 31, 1

SIR: I have the honor to propose an electrical torpedo-boat which can be pro steered, and fired by electricity, and which requires but one wire between it a operator.

The current being generated by the dynamo D, shown in the inclosed sketch, through the pole-changer K and short-circuiting key K′, thence through the s rine cable into the torpedo-boat, through the cable wound on a reel in the chamber, through the electro-motor D′, thence to earth. The revolutions electro-motor produced by the current are communicated to the propeller by th shaft, thus producing propulsion of the torpedo-boat.



Design for Propelling, Steering, &

the engine stopped, when it was observed that the boat took up a list of several degrees to starboard, showing that she had been ballasted against the action of the propeller but not sufficiently. The Board was informed that this was the first run had with the propeller used.

As it had been determined that the trial should be to show the action of the boat generally, and not with special reference to speed, the course was somewhat irregular to show that she was under control of the operator on shore. The boat answered her starboard helm very quickly, turning rapidly under its influence; with the port helm she was not so quick, but as a whole, it may be said that the direction of the boat is under the control of the manipulator on shore.

The general course steered was toward a spar buoy said to be one-half mile from the starting point, the buoy having been located by reputable surveyors of Bridgeport and New Haven. The boat passed near the buoy, but on the inshore side, two minutes after the engines were started, so far as could be seen from the position occupied by the Board. No person was stationed near the buoy. The tide had been running ebb about one hour and a half and was of about two knots strength. Its direction was from a point about 45° to starboard of the bearing of the buoy.

A light breeze—force 2—was with the tide, and a slight ripple followed wind and tide. The engines of the boat slowed down very perceptibly at the end of two minutes, working on two minutes more at a rapidly decreasing speed. A small boat was sent out to tow it back to the cradle, and in about thirty minutes the torpedo was in the rests and hauled up into the shed.

The attention of the Board was called to the fact that a part of its outer shell was warmer than the atmosphere.

The boat was now opened to allow the Board to see and examine the interior. The points of difference between this boat and the Lay Haight boat now at the Torpedo Station are: first, in the size and weight of the boat; and, second, in the method used for expanding the liquid carbonic acid and maintaining it at a sufficiently high temperature. This boat is one foot and a half longer, and five inches smaller in diameter, and weighs but 1,295 pounds. The expander is a copper cylinder 12 inches in diameter and 48 inches in length, containing a coil of 75 feet of pipe, 75-inch internal diameter. This coil is disposed in the lower part of the cylinder, and is immersed in dilute sulphuric acid—77.5 pounds acid to 20.5 pounds of water. In the upper part of the cylinder there is hung on a longitudinal axis a copper trough containing 11.5 pounds of lime. The top of this trough is covered with a rubber cloth, cemented to its edges. Underneath this cloth a chain is run which is secured by several hooks to the main or outside cylinder. The axis is continued at one end through a stuffing-box and has a cogged wheel which gears into a worm; this latter can be turned by a crank shipped from outside the boat.

The action of the expander is as follows: When it is desired to run the boat, the carbonic acid stop-valve being opened, and the crank mentioned above turned, the throttle-valve is opened by the electrical apparatus, the liquid carbonic acid flows from the bottom of the flask through the valves into the piping, where it expands, and where the natural lowering of temperature is prevented by its being surrounded with the heating mixture, which is capable of maintaining a high temperature for a considerable time. The sketch marked "B," herewith appended, shows the arrangement of the apparatus. Thirty-five minutes after the engines stopped, the cover having been taken off for the purpose, the following temperatures were observed, namely, sea-water, 38°; air, 46°; expander compartment, 85°; interior of expander cylinder, 210° F. All pipes, connections, the engines, and other parts, were free from any sign of frost or ice. The wire used was about $\frac{3}{64}$ inch in diameter, insulated with gutta-percha. The insulation increased its diameter to about $\frac{1}{8}$ inch, and its length was said to be one statute mile.

The engine is of the Brotherhood type cylinder, 3.75 inches diameter, length of stroke 2.5 inches. The pressure that follows full stroke is said to be 250 pounds.

The propeller is two-bladed, 18 inches pitch, 15.5 inches diameter, and runs at twice the speed of the engine. The flask for carbonic acid contained 110 pounds of liquid acid, its capacity being 3.5 cubic feet approximately.

A second trial for direct run and speed was delayed until the afternoon of the 31 instant by bad weather, ice blocking up the harbor, and low tides. Shortly after tide of that day the Board was present prepared to determine the speed over the mile. To determine whether the speed was uniform, an additional buoy had been placed midway between the starting and half-mile buoys, under the supervision of Mr. H. J. Kellogg, civil engineer, a copy of whose certificate is herewith appended, marked "C." Watches were compared and members of the Board stationed at most advantageous points to observe the passage of the torpedo, one member going out in a boat to the half-mile buoy. A system of signals was arranged by which the times of passing the three buoys could be taken by each observer.

Everything being reported ready, the car was run into the water, the boat launched clear, and the word "go" given, but the engines failed to start and the boat gradu-

ally sank, stern first, her bow remaining out of water. She was now towed in and onto the car, and hauled up, and on being opened it was found that the electrical apparatus was out of order, and that the workmen had failed to put into the cable compartment, which is open to water, two tin cans meant to exclude a portion of the water; the loss of their buoyancy, 20 pounds, accounting for the sinking of the boat. In the expander compartment it was noticed that the heating mixture had leaked out from the expander cylinder. This was owing to the fact that the two glands at the ends of the coil were not properly set up; they were not even hand-tight.

Mr. Haight, the inventor of the electric apparatus, operated the key-board on this occasion, and the entire manipulation of the boat and its appliances was by the employés of the Torpedo Company. It was determined to have another trial at daylight the next morning, when the company said everything would be ready, provided the tide served well; but the morning tide proved to be too scant for the run over the course, and the bay beginning to fill with ice from the severe cold, the company concluded to abandon any further efforts for another trial at that juncture—wherefore the Board adjourned and its members returned to their several stations.

Very respectfully, your obedient servants,

GEO. E. BELKNAP,
Captain, U. S. N., and President of Board.
E. O. MATTHEWS,
Captain, U. S. N., and Member of Board.
THEO. F. JEWELL,
Lieutenant-Commander, U. S. N., and Member of Board.
W. MAYNARD,
Lieutenant, U. S. N., and Member of Board.
A. R. COUDEN,
Lieutenant, U. S. N., and Member of Board.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy, Washington, D. C.

C.

MILFORD, CONN., *March* 3, 1884.

DEAR SIR: I have this day made a survey of the course at Milford, Conn., where torpedo experiments are being made by Mr. Winsor, and can certify that the distance from inner to outer buoy is one-half mile, and that I have located a buoy half-way between the said inner and outer buoys.

Respectfully, yours,

H. J. KELLOGG,
Civil Engineer.

Captain BELKNAP,
President Torpedo Board.

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U. S. TRAINING SQUADRON, U. S. FLAGSHIP NEW HAMPSHIRE,
Newport, R. I., March 5, 1884.

SIR: Agreeably to Department's order of February 20, I repaired to Milford, Conn., on the 28th, and witnessed a trial of the Lay torpedo boat.

The trial was, in the main, satisfactory, but as additional data were required further tests were deferred till the following day.

On the 29th Milford Haven became packed with ice, and no further attempts were e till the 3d of October. On that day the boat was placed in the water, but owing a oversight on the part of one of the employés the wires failed to work, and no her trial was made.

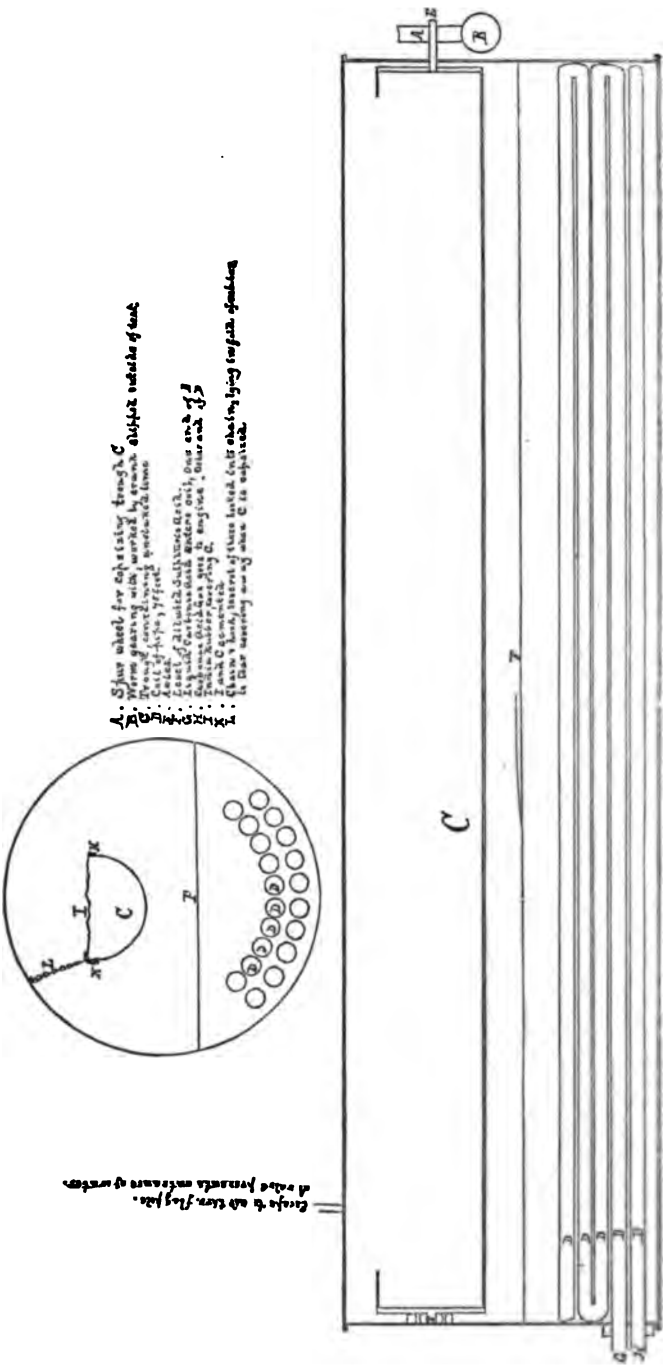
justice to the owners of the torpedo it should be stated that this failure did not ar to be attributable to any error in principle, or defect in its construction.

boat is known under the name of the "Combination Torpedo," and is owned by the American Torpedo Company.

It may be briefly described as a steel cylinder with tapered ends. It is made up our sections, has a total length of twenty-four feet by fourteen inches diameter; capable of carrying 100 pounds of dynamite, and weighs when ready for service about 1,300 pounds.

The motive power is carbonic acid gas, which operates a Brotherhood engine with a two-to-one gearing and a two-bladed propeller.

In one of the compartments into which the boat is divided is placed a coil of single d copper wire, the length of which limits the controllable range of the boat.


A. Spur wheel for capsizing trough C
B. Worm gearing with, worked by crank shipped outside of tank
C. Trough, containing unslacked lime
D. Coil of pipe, 75 feet.
E. Axles.
F. Level of diluted Sulphuric Acid.
G. Liquid Carbonic Acid enters coil, One end of D
H. Carbonic Acid Gas goes to engine, Other end of D
I. India Rubber, covering C.
K. I and C cemented
C
F

present instance this range was said to be half a mile. The standing part re was attached to the transmitter placed near the midship body of the

nning part passes out through the axis of the shaft beyond the propeller ce to the key-board.

ctric current was generated by a chemical battery of 50 cells.

ns of the one wire the operator, placed at the key-board, is enabled to perfollowing functions: to start the engine; to stop it; to put the helm to starıd put it to port; to fire the charge at will; to fire the charge by contact.

lm, being retained in its normal position amidships by means of a steel spring, he position of "*steady*" as soon as released from *starboard* or *port*.

dder is placed forward of the propeller and can be moved over an arc of 35° axis of the boat.

he throttle open and the rudder amidships it is obvious that the boat will a course until the wire is expended; then severing the wire connection at tter, it will continue a theoretically straight course till the motive power hausted.

at was put afloat in smooth water at 2 p. m. on the 28th, wind northwest from tide ebb; course nearly at right angles to wind and tide. It started off at te of speed and seemed to be under the full control of the operator, going ard and to port as desired.

ace gone over was judged to be about half a mile, and the time recorded minutes; but these estimates are too rough to be relied upon.

earlier trials it was found that the rapid evolution of gas reduced the temin the chambers to the freezing point. This difficulty is now sought to be by the use of a chemical heater; but while believed to be successful, the the temperature in time to verify the assumption was not practicable.

he trial of the 28th, I am led to conclude that the movements of the "Com-Torpedo" may be controlled in smooth water while within the limits of

.

e larger-sized boats carrying a mile and a half of wire would have sufficient all practical purposes.

ith the operator and observer placed within bomb-proof chambers, under ction of heavy batteries, they would prove formidable adjuncts to the deorks of rivers and harbors.

ey can be operated at night without the protection of batteries.

om monitors as bases they could be projected against an enemy's fleet with ct.

ey can be sent beyond the controllable range, by dropping the wire, and as long as the motive power lasts.

ry respectfully, your obedient servant,

S. B. LUCE,
Commodore, United States Navy, Commanding Training Squadron.

ILLIAM E. CHANDLER,
retary of the Navy, Washington, D. C.

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1884

UNITED STATES RECEIVING SHIP COLORADO,
NAVY-YARD, BROOKLYN, *March* 8, 1884.

obedience to your orders of February 20, ult., I have to make the following the result of the trial of the "Combination" torpedo-boat which took place at Conn., on February 28. The boat experimented with is 26 feet in length ches greatest diameter—propelled by a two-bladed screw of 15½ inches diam-18 inches pitch. The weight of boat, when charged for ordinary work, is be-00 and 1,300 pounds—the displacement of boat between 1,400 and 1,500 The flask containing the motive power (liquid carbonic acid) is of the same versely as the other cylindrical portions of the boat, and takes its place in gement as one of the sections of the hull.

xpander," a copper cylinder surrounding the pipes which lead from the *flask* to e, is filled with a solution of sulphuric acid, lime, and water; it is a new feae torpedo and *is an improvement*, as it prevents congelation in the pipes, cylc., and allows the full force of the gas to be used in propelling the boat. irst run, which was a trial for steering, the boat obeyed the helm readily ned *to port*, but was slower when turning *to starboard*, owing to the action of . After the run the boat was towed in and opened, the interior was warm ed the good effect of the sulphuric acid mixture in preventing congelation id. The amount of *liquid carbonic acid* carried in the flask experimented

with was about 110 pounds, with a square inch pressure of about 800 pounds. The single wire which connected the boat with the shore station was of English make, No. 55, Stubbs' gauge, and the currents sent through it to perform the movements in the different valves of the engine were effective.

A boat of these dimensions carries too limited motive power and wire for effective work in anything but narrow water-ways with deep channels; it could be easily stowed on board ship, as also the flasks and other apparatus, but the delicacy of the instruments, their liability to disarrangement, and the extreme care necessary to prevent any interruption of the electrical current, by which the functions of the boat would be paralyzed, the intricate arrangement of wires, all of which require the careful hand of an expert, together with the difficulty of obtaining space on board in which to generate the motive gas, all militate against their being carried as part of the armament of cruisers exposed to all the heroic movements of the storm waves and cross seas which that class of vessel must encounter, while it is evidently impracticable to manipulate them from a vessel in motion against another moving object.

On the other hand, this "combination" boat seems adapted especially to the defense of ports, harbors, narrow channels of rivers, and even of open roadsteads, when manipulated from the decks of vessels anchored therein. Under these circumstances this torpedo can be handled almost as accurately as a common steam-launch by helmsman. It would be a valuable attachment to a monitor at anchor for the protection of an outside channel, and would make the running down or ramming of such a vessel a difficult and improbable feat.

A trial for speed was to have been attempted on March 3, but owing to the carelessness of some of the company's employés, the connections were erroneous, the tin air-tanks in the wire compartment were left out, and the torpedo, on being launched, sunk. This, although a part of the trial, should not militate against the usefulness and capabilities of the torpedo as already proven. There being no probable opportunity for another speed trial, the Board having separated, I beg to present this as my report of the result of the trial.

I am, sir, respectfully, &c.,

W. A. KIRKLAND,
Captain, United States Navy.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy, Washington, D. C.

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1884

PHILADELPHIA, PA., *March* 8, 1884.

SIR: In obedience to the order of the Department, of the 21st February—direc me to proceed to Milford, Conn., to witness the trial of a Lay torpedo-boat on the ... of that month—I have the honor to submit the following report:

I arrived at Milford, Conn., on the afternoon of February 27, and on the afternoon of the 28th, in company with a number of naval officers and other gentlemen witnessed the launching and running of the torpedo-boat, the method of taking the boat out of the water after she had been towed back to the shore, the taking off of the several removable covers forming a considerable portion of the top of the hull, and examined, as thoroughly as the occasion and circumstances would permit, the mechanism of various sorts contained within, and the method of construction pursued, as well as the function performed by the various parts, composing a very curious and interesting, as well as formidable implement of war

I left Milford on Tuesday, the 4th of March.

The hull of the boat is 24 feet 8¾ inches long from the forward edge of the stem to the after end of the metallic portion of the stern compartment. A wooden tampion extends 1¼ inches beyond this. From the end of the firing-pin, piercing the stem, to the end of the tube secured to the sc ew-propeller's hub, and projecting 5 inches beyond it, the distance or length is 26 feet. When equipped for service the boat is said to weigh 1,295 pounds.

The hull is of metal, and is cylindrical in form, except the bow and stern compartments, and is 14 inches external diameter. The sheet metal of the hull, excep bow compartment, is open-hearth steel $\frac{3}{64}$ inch thick, and made by Singer & Ni of Pittsburgh, Pa. The bow compartment is made of sheet brass $\frac{1}{16}$ inch thick, and has a straight cast brass ve tical stem, pierced at its middle by the firing-pin.

The carbonic acid container or flask is wrought iron and forms a compartment of the hull. There are eight compartments in all, of different lengths, formed by seven bulkheads of steel $\frac{1}{8}$ inch thick and riveted to brass flanges 1¼ inch broad at their periphery, to which the plates of the hull are riveted. Each compartment, except the flask, is capable of being opened. Those two situated forward of the flask have arm-holes in them on top, and the five situated abaft the flask have removable covers

ig from one-third to one-half the circumference of the hull and of the full l of their compartments, except the after one, where the removable cover is two-thirds of its length. The top of the hull is perfectly straight from stem rn, and the bottom is perfectly straight and parallel to the top from the stern to eginning of the aftermost compartment—which is 53½ inches long—where it upward toward the top and terminates, 3 inches from it, at the extreme after stern—the three-inch hole then being closed by a wooden tampion.

hull is built in two parts, and between them the flask is inserted, which makes parts comprising the completed boat.

bow or forward compartment is wedge-shaped, and when viewed in projection the horizontal central plane presents the form of a longitudinal section of half elliptic spindle. This compartment is 34½ inches long from the forward edge of em to the bulkheads at its after end, where it is 14 inches diameter. It is to n the explosive and the electrical apparatus for firing it.

next compartment abaft it is cylindrical in form, 36 inches long and 14 inches ter, and is empty, filled with air. Upon its arm-hole cover stands the sight or rod, with a small flag attached to its head. The after bulkhead of this comment is entirely of steel, there being no brass flange riveted to it; it is concave after side to conform to the head or end of the flask. These two compartments he forward removable portion of the hull.

flask, which is inserted here, is secured by a central stud, 1½ inches diameter, l upon its end, to the concave bulkhead, which it pierces, and, receiving a gromrasher, and nut on the opposite side, binds them firmly and tightly together. isk is wrought iron, 36 inches long, exclusive of its dome-shaped ends, which are x and formed to a 10-inch radius, and is 14 inches diameter. It forms the third rtment of the hull, and one of the removable parts of the boat. The after able portion of the hull is secured to the flask in a similar manner to the forremovable portion, the 1½-inch stud forged upon the flask's end piercing the el bulkhead, and, by the grommet, washer, and nut, binding them firmly and y together.

fourth compartment is cylindrical in form, 72 inches long and 14 inches diameter. tains the heater. The pipes connecting the flask with the propelling, starting eering engines pass through this compartment. Upon the after end of its revle cover stands a tube, open to the cavity of the hull, and is one of the guide

fifth compartment is 16½ inches long and 14 inches diameter. It contains the conductor and two tin floats. The pipes to the engines also pass through this rtment. The conductor or cable tube begins here and opens through the after ead, its mouth being 3 inches diameter.

sixth compartment is cylindrical, 33½ inches long and 14 inches diameter. It ns the controlling or throttle valve, the starting engine and its electro-magnet, lucing valve in the pipe, connecting the flask with the starting and steering s, and the current director. The pipes to the engines abaft and the conductor ass through this compartment.

seventh compartment is cylindrical, 15 inches long and 14 inches diameter. It ns the propelling engine, its exhaust pipe passing out at the bottom of the boat ts end turned af , beneath. The pipes to the engines abaft and the conductor ass through this compartment.

eighth and last compartment is a frustum of a cone, the parallel plane of the nd vertex being perpendicular to a slant side. It is 53½ inches long and is 14 diameter at forward end and 3 inches diameter at after end. It contains the heels of the engine, the crank shaft and its journal, the steering engine and its -magnet, the rudder-head and yoke, the spring for steadying the rudder, and opeller shaft.

everal places provision is made for the escape of any pressure which might exhin the cavity of the hull by escape valves opening outboard.

motive agent employed is carbonic acid gas. The motive machinery consists ntainer or flask for the liquid carbonic acid and any gas existing in connection , a heater and expander for gasifying the liquid acid and expanding it, and for ing heat to compensate for that absorbed by the gasification of the liquid acid; ine for actuating the screw-propeller, an engine for actuating the rudder, and ine for actuating the controlling or throttle-valve of the propelling engine.

flask is wrought iron, without seam or joint of any kind, being an entire forglded up and formed to the required shape. It is a cylinder 36 inches long and es diameter externally, with convex ends, upon each of which is forged a cenid 1½ inches diameter, threaded, and of sufficient length to accommodate the and nut used in binding the bow and stern portions of the hull firmly to it. ickness of metal of cylinder portion is three-eighths inch; that of the ends is sixteenths inch; radius of convex ends, 10 inches; weight of flask, empty, 224 ; tested by maker to 1,800 pounds per square inch; made at Green Point,

Brooklyn, N. Y. Through its axis passes a $\frac{1}{4}$-inch copper tube, fixed at one end and packed at the other, for passing the electric conductor to the explosive in the bow of the boat. Upon its after end, and as high up as possible, is located, in one casting of copper, the two stop-valves for drawing off the contents of the flask. From the larger orifice an internal pipe turns downward to the bottom of the flask for drawing off the liquid acid, and from the smaller a similar pipe turns upward to the top of the flask for drawing off the gas. The diameters, respectively, of these orifices are $\frac{5}{32}$ inch and $\frac{1}{8}$ inch. There are no other attachments to the flask. The contents of the flask weigh 110 pounds, and will run the boat at full speed one-half mile, and a considerable distance farther, say a quarter mile, at a constantly diminishing speed, until the engine stops for want of gas. This charge of 110 pounds fills the flask about two-thirds full, and it is deemed best not to exceed that quantity. The pressure within the flask, when charged and at the temperature of melting ice, is 450 pounds per square inch. It increases with an increase of temperature, and at 60° will probably be 800 or 850 pounds, and at 80° probably 1,000 or 1,050 pounds. When the run was made on the 28th of February the pressure was probably 500 or 550 pounds.

The larger orifice supplies the propelling engine, and the smaller supplies the starting and steering engines. A $\frac{3}{8}$-inch copper pipe, in which there is a strainer located, connects the $\frac{5}{32}$-inch orifice with the controlling or throttle valve, and thence with the expander. A $\frac{1}{8}$-inch copper pipe connects the $\frac{1}{8}$-inch orifice with the reducing valve, and thence with the starting and steering engines.

The heater and expander perform a very important function, in connection with the motive agent employed, by supplying heat to compensate for that absorbed by the gasification of the liquid acid, and preventing the formation of ice and frost within the cavity of the hull.

The heater is a cylinder of sheet copper with flat ends, 48 inches long and $12\frac{3}{4}$ inches diameter externally; the thickness of metal of the cylinder is $\frac{1}{16}$ inch and of the ends $\frac{1}{8}$ inch. One of the flat ends is removable, and is secured in its place by a number of small screws, which screw into a stout ring on the inside and at the end of the cylinder; a tube $\frac{1}{4}$ inch diameter pierces the removable end, and, turning upward, has its open end just beneath the tube on the outside of the hull, and which is one of the guide-rods, the after one. There is a hole through the cylinder for charging it, closed with a screw-plug.

The expander is within the heater, and consists of 20 pieces of $\frac{3}{4}$-inch copper pipe laid parallel to each other and the cylinder, and connected together at their ends by half turns, or U-shaped pieces; each pipe is 44 inches long, and they are arranged in two courses, following the curve of the cylinder, and extend up to about its horizontal central plane on each side; they are kept about one-half inch from its surface by curved pieces of copper provided with the proper holes, through which the pipes pass. The first and last pipe of this system pierce the removable end of the heater, and, by means of washers and nuts, are made tight at their juncture with it.

Above this system of pipes is located a trough made of a 4-inch copper pipe, supported at one end upon a loop hanger secured to the shell of the cylinder, and its other end has a stem or spindle upon it which pierces the removable end of the heater and is provided with a stuffing-box; upon this spindle, outside, is a cog-wheel, into which fits a wormed shaft, secured to the hull, for capsizing the trough, which is done by a crank applied on the outside of the boat. This trough is filled with quicklime, and when filled its open side is sealed up with a piece of thin sheet gum, glued over it with liquid cement. One edge of this piece of gum is made to receive several hooks, depending from the shell of the heater, which tear it off from the trough when it is capsized. The weight of the heater, empty, but with all its internal pipes and the trough, is 183 pounds. It is filled three-fifths full with dilute sulphuric acid.

The charge is $11\frac{1}{2}$ pounds of quicklime in the trough, $77\frac{1}{2}$ pounds of commercial sulphuric acid, and $20\frac{1}{2}$ pounds of water.

The $\frac{3}{8}$-inch pipe from the controlling or throttle valve connects to the expander where it pierces the end of the heater; the other open pipe of the expander receives a $\frac{3}{4}$-inch pipe which passes to the propelling engine and conducts the gas to it.

The propelling engine is of a type known as the Brotherhood engine. It has three single-acting cylinders contained in one casting, and arranged equidistant in a plane perpendicular to one common crank-pin. The cylinders are each $3\frac{3}{8}$ inches diameter, and the stroke of pistons is $2\frac{1}{2}$ inches; the length of the pistons (a short trunk) is $2\frac{1}{4}$ inches; their packing is a piece of leather filling a groove $\frac{1}{4}$-inch wide and $\frac{5}{32}$-inch deep. The cylinders have removable heads on their top or outboard ends, secured to flanges by screws with hard paper joints beneath them. The central cavity into which all the cylinders open at their lower ends is closed by a circular bonnet on each side, and they are put on similarly to the cylinder heads; the gas is introduced into this cavity; the inlet-pipe is $\frac{3}{4}$-inch diameter. One of these bonnets is pierced by the crank-shaft and forms its principal journal; the escape of gas in this direction is prevented by a collar on the shaft, pressed tightly against the vertical surface by the internal pressure.

The opposite bonnet contains the valve's seat and the passages to the outside ends of

ʼs, beneath their covers, and to the exhaust-pipe. The diameter of this central s $4\frac{1}{4}$ inches; the distance from bonnet to bonnet is $5\frac{3}{4}$ inches. The thickness l of cylinders is $\frac{1}{4}$ inch; of pistons, $\frac{3}{8}$ inch; of trunk portion, $\frac{1}{4}$ inch; of bonl heads, $\frac{1}{4}$ inch.

istributing-valve is placed in a cavity which it exactly fills, and is covered by of metal properly parted for the admission of gas to the valve revolving it, and it is secured by screws to the surrounding flat surface. The function ılate is to keep the pressure off the valve. The valve is revolved vertically at by the end of the crank-pin; it is provided with one through port for adthe pressure to the top of the pistons beneath the cylinder-covers, one at a d with one exhaust-cavity in its under si e for withdrawing the pressure from of the pistons, two at a time.

alve seat has three ports for receiving the gas from the port through the hence it is conveyed to the top of the pistons throught he gas-passage; this is $\frac{1}{16}$ by $1\frac{1}{4}$ inches. The pressure thus introduced on top of the piston counthe pressure constantly acting beneath it, and consequently this piston is ibrium as long as the pressure is retained upon it. Whilst the pressure is ıtroduced upon the top of one piston, through the port through the valve for pose, the pressure is being withdrawn from the tops of the other two pistons the exhaust-cavity in the under side of the valve, which is in action, and is ged into the sea through the exhaust-pipe; the exhaust-pipe is $1\frac{1}{4}$ inches diamlotion ensues and continues until the moving force is withdrawn.

istributing-valve is $3\frac{1}{2}$ inches diameter and it is $\frac{13}{16}$ inch thick; its through $\frac{1}{8}$ by $2\frac{3}{8}$ inches; its exhaust-cavity is 3 inches. It has a crank attached to it ıtral threaded hole for revolving it. The cylinders, pistons, cylinder heads, , and the valve are cast-iron. The circumscribing circle of the cylinders is es diameter.

onnecting-rods are gun metal and they are $4\frac{7}{16}$ inches long from center to f eyes. They are articulated to the pistons by through steel pins one-half inch r; the boss at piston end is 1 inch diameter and seven-eighths inch in direcournal; the boss at crank-pin end is $1\frac{1}{2}$ inches diameter and length on journal s for the middle one: the other two rods are forked and each fork has a bearing on crank-pin five-eighths inches long; the diameter of the bosses is $1\frac{1}{4}$ The diameter of the rods is three-fourths inches at their necks, and their ection is 1 by $\frac{7}{16}$ inches. They are not adjustable.

ank-shaft, crank, and crank-pin are steel, the crank and shaft being in one The shaft is $1\frac{5}{8}$ inches diameter and 12 inches long; the crank-pin is $\frac{15}{16}$ inches r and $4\frac{3}{8}$ inches long. The end of the pin is reduced to $\frac{1}{2}$ inch in diameter, rs a hole in the crank attached to the distributing-valve, by which it is re-

ıgine is bolted firmly to the after bulkhead of its compartment, which is made ly thicker metal than the others on that account. A h le is cut through the d into which the bonnet of the engine exactly fits, serving as a guide for acplacing the engine. The crank-shaft, projecting beyond, is supported in a box near its end, formed upon a stretcher across the hull, to which it is riveted ds by flanges. The gear-wheels are located just abaft this bulkhead; they el, $1\frac{1}{4}$ inches face. The spur has 36 teeth and is 6-inch pitch; it is secured to its a through pin. The pinion has 18 teeth, and is secured to its shaft by a key. tiple is as 1 to 2.

rew-propeller shaft is a steel tube $1\frac{1}{4}$ inches diameter outside and $1\frac{1}{8}$ inches dinside, except near its ends, where it is less, being only a trifle greater than uctor-tube which passes through it; the shaft is $54\frac{3}{4}$ inches long. The conabe is brass, 1 inch diameter outside and seven-eighths inches inside; it passes to the propeller-shaft, which revolves about it. The inboard end of the shaft aring in the bulkhead to which the engine is secured, and against which the delivered by means of a collar upon the shaft and two loose steel washers against the end of the bearing, which terminates on the opposite side of the d, beneath the engine, in a stuffing-box around the conductor-tube for excludwater at that point. The conductor-tube passes on forward to the bulkhead onductor compartment and terminates upon it in an enlarged mouth and ght joint.

ıaft has another bearing in the stuffing-box where it passes out through the l another in the hanger secured to the hull at its extreme after end. On the side of the hanger, which is brass, is a brass collar secured to the shaft to it from rigging outboard.

rew-propeller is secured to the shaft just abaft this hanger, and the shaft is ced in size nor tapered for the reception of the screw. The screw is brass ıhed all over, and is two-bladed and not expanding. It is 16 inches diameter ıches pitch; the hub is $2\frac{1}{4}$ inches diameter and $3\frac{3}{8}$ inches long. The blades are angles to the axis of the screw and have their corners slightly rounded. The

width of the blade, measured on its surface, is 5¼ inches at the periphery and 2¼ inches at the hub; the length from hub to periphery is 7 inches. When viewed upon a plane parallel to its axis, each blade has its edges parallel, and they are perpendicular to that axis. The length of the blade in the direction of the axis is 2¼ inches at the periphery and 2¼ inches at the hub. When viewed, in projection, upon a plane at right angles to its axis, each blade shows a width of 5 inches at the periphery and 1¼ inches at the hub.

The weight of the screw is 3¼ pounds; area of blades, 54 square inches.

A tube 5 inches long and 1 inch diameter outside is fixed to the after end of the hub.

The rudder is located forward of the hanger, in the after part of the triangular space inclosed by the shaft, for base, the hanger for perpendicular, and the hull for hypothenuse of the triangle. The blade is metal, ⅛ inch thick; it is 12¼ inches long from post to after edge of blade, 3¾ inches wide at the post, and 6 inches wide at the after edge. The remaining portion of the triangular space above described and forward of the rudder is filled in with wood. The heel of the rudder-post steps into a metal shoe secured to this wood, and its head passes through a brass casting secured to the hull inside, and has a stuffing-box for excluding the water. A yoke secured to the rudder-head has a roller in one end working against a V formed in a stiff spring which is secured to the hull; the function of this spring is to midship the rudder whenever the steering engine releases it. The other end of the yoke is connected by a jointed rod to the piston-rod of the steering engine, by which the rudder is put to port or to starboard at will, according to the direction in which the piston is made to move.

The steering-engine is a double-acting cylinder of 3-inch stroke of piston and 2¼-inch diameter, secured horizontally to the hull. It is fitted with a three-ported slide-valve, balanced between the seat upon which it slides and its chest-cover. The pressure is admitted to either side of the piston by ports down through the valve, which are brought into action by moving the valve either to right or left. If desired to port the helm, the valve of the steering-engine is moved in the proper direction for admitting the moving agent to the proper side of the piston, and, being present in the supply-pipe, it enters through the opened port and pushes the piston to the end of its stroke, which moves the helm to port. To steady the helm the valve is brought to midstroke, which shuts off the flow from the supply-pipe and releases the pressure in the cylinder at the same instant, and the V in the spring acting upon the roller in the end of the yoke brings the helm amidships. The helm can be put to starboard by a similar process.

The movements of the valve of the steering-engine are made by the action of a double electro-magnet of considerable power located near it, and connected by levers to the valve.

The starting-engine is in all respects similar to the steering-engine, except the length of its piston-stroke, which is ½ inch, its diameter being 2¼ inches. Its piston-rod is connected directly to the stem of the controlling or throttle valve, which is of the equilibrium type, and opens or closes it at will by the movement of its piston. The valve of this engine is three-ported and balanced just like that of the steering-engine, and is governed by an electro-magnet of the same size and construction, and similarly located.

The stop-valves on the flask are opened from the outside of the boat by a socket-wrench. They can be opened at any time, either just before the boat is launched or a considerable time before. When they are opened the gasified acid, taken from the top of the flask, fills the pipe connecting it with the starting and steering engines to their balanced slide-valves, and is ready to act upon their pistons whenever their valves are opened. The reducing-valve in this pipe is for the purpose of reducing the pressure of the gas supplied to these engines, and is said to reduce it one-half, or from 450 or 500 pounds to 225 or 250 pounds per square inch, which is the pressure actuating their pistons.

The liquid acid, taken from the bottom of the flask, fills the pipe connecting it with the propelling-engine as far as the controlling or throttle valve. When this valve is opened the liquid acid passes it, and, entering the expander, becomes gasified and expanded and then passes on to the engine, where it is said to exert a pressure of 250 pounds per square inch or more. The engine starts instantly and continues its motion until the throttle-valve is closed or the contents of the flask exhausted.

The usual plan pursued is to get the boat ready for launching with the flask and heater properly charged, electric conductor properly connected inside the boat and to the battery and earth. This accomplished, the stop-valves on the flask are opened, the trough in the heater containing the quicklime is capsized, and when the heat is well up, which is manifested by the rapid escape of steam from the top of the tube fixed in the hull of the boat just over the escape-pipe from the heater, the launch is made, and when the boat is well clear of the launching-carriage the engine is started and the voyage begins.

revolutions of the engine are said to be upwards of 600 per minute, the screw ing twice that number.

The five electric functions of go, stop, port, starboard, and fire are performed by ingle conductor, which is a very small copper wire insulated with gutta-percha, d measures over its insulation ¼ inch diameter.

witnessed one trial on the afternoon of the 28th of February. The launch was y successfully made and the boat ran off very swiftly for a short time, say two or ee minutes. She was turned both to port and to starboard, and finally turned ard the shore; she continued to go until the contents of the flask were consumed. wind was fresh and at right angles to the course run.

he boat was then towed in to the launching-carriage and taken out of the water, the removable covers taken off by taking out a multitude of little screws. She been in the water about 40 minutes (from launching to opening 42 minutes). temperature of the air was 46°, that of the water 38°. The temperature of the ity of the hull in the vicinity of the heater was 85°; the temperature inside the ter, through the filling-up hole, was 201°. There was no frost upon any of the ts inside the hull; the engines and pipes were cold to the touch, but not exceedly cold.

second trial was attempted on the afternoon of Monday, March 3, but the boat ld not go, on account of some derangement in the current transmitter. The trial then fixed for the morning of the 4th, but owing to ice along the shore and an unally low tide it was postponed.

he material and workmanship are good and the machinery is well adapted to the poses for which it is employed.

espectfully submitted.

A. J. KIERSTED,
Chief Engineer United States Navy.

on. WM. E. CHANDLER,
Secretary of the Navy.

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1884

UNITED STATES NAVY-YARD,
Norfolk, Va., July 11, 1884.

IR: I have the honor to transmit herewith the report of the proceedings and finds of the Naval Torpedo Board up to the 25th ultimo, inclusive.

he report embraces examination and tests of the surface torpedo, presented by the erican Torpedo Company of New York; the surface rocket torpedo presented by Asa Weeks, of Washington; and the subaqueous torpedo, presented by Capt. John Howell, United States Navy.

o other competitors appeared before the Board with torpedoes in readiness for l, as required by the instructions of the Bureau of Ordnance and the terms of the lic notices given by the Board.

Very respectfully, your obedient servant,

GEORGE E. BELKNAP,
Captain United States Navy, and President Torpedo Board.

on. WM. E. CHANDLER,
Secretary of the Navy, Washington, D. C.

UNITED STATES NAVY-YARD,
Norfolk, Va., June 25, 1884.

IR: The Torpedo Board appointed by the Department November 24, 1883, pursuant he act of Congress approved March 3, 1883, concerning "the purchase and manuure of torpedoes adapted to naval warfare," has the honor to submit the following rt, based upon its observations and experiments up to the present time:

he work and procedure of the Board were governed by the terms of the order ting it, the instructions issued for its guidance by the Bureau of Ordnance, and Bureau's circular letter to inventors and competitors, copies of which are heren appended and marked A, B, and C, respectively. Public notice of meetings of board was also twice given by advertisement in the papers in various parts of the ntry, as per appended copies, marked D and E.

he Board first convened at Milford, Conn., February 28, 1884, to witness trials of torpedo presented by the American Torpedo Company of New York, and of which ial report was made to the Department immediately thereafter. Subsequently to

that date the Board held other sessions at that point, as well as at Norfolk and Washington and the waters of Hampton Roads and the Chesapeake, for the examination and test of the torpedoes presented, as per memoranda of trials herewith appended, marked F, G, and H.

Three types of automobile torpedoes were submitted to the Board for examination and test.

First. The surface torpedo, presented by the American Torpedo Company, which is substantially a modification of the torpedo commonly known as the Lay-Haight, its motive power being carbonic-acid gas acting upon a Brotherhood engine, and steered by electricity.

Second. The Weeks surface rocket torpedo, presented by Mr. Asa Weeks, its motive power being, as its name indicates, a rocket.

Third. The Howell subaqueous torpedo, presented by Capt. John A. Howell, U. S. N., its motive power consisting of a steel fly-wheel revolving within a water-tight iron shell, set in rapid motion by the application of a jet of steam at high pressure for the length of time required.

And the Board, having carefully examined all the machines brought before it, and tested them as far as their distinctive features and the readiness of the competitors for the exhaustive trials required would admit, submits in detail its conclusions with regard to their adaptation for naval warfare.

TORPEDO OF THE AMERICAN TORPEDO COMPANY.

Accuracy: Good, with reference to a fixed object in smooth water; not determined with reference to a target in rapid motion, nor in rough water where the seas might at times hide the course of the torpedo from the operator. The torpedo is steered by an electric current passing through insulated cables connecting the machine with the operator, stationed either afloat or ashore, as the occasion may require.

Range: Good, the distance, at speed when the machine works well, being half a statute mile.

Velocity: Fair; but other torpedoes, notably in Europe, surpass it.

CERTAINTY OF OPERATION.

a. Certainty of launching and starting on its course: Good, so far as tests not made in actual service at sea could show; but the Board regards the apparatus used as utterly unfit for the purpose in a seaway, under the conditions that naval warfare constantly imposes.

b. Certainty of explosive action on contact with target: Undetermined; plan submitted which would probably be efficient.

Destructiveness: Doubtful, as the efficiency of a surface torpedo as to destructive effect has yet to be shown by actual test.

Safety in handling: Measurably safe; but the safety of a torpedo may be regarded as an utterly unknown quantity in a naval combat.

Facility of handling: Awkward, owing to its length, bulk, and weight.

Simplicity: Complex.

Ability to be operated with safety from an enemy's fire: Not good; some exposure unavoidable; but, under the conditions of naval warfare to-day, with the enormous powers of defense afforded by machine guns of great range and power, torpedoes of great length, like the one in question, would prove dangerous to handle under the fire of an enemy.

Simplicity of launching apparatus: No apparatus submitted that would answer the purpose in a seaway, rendering the torpedo incomplete in that respect.

Efficiency as to launching at an object: See foregoing answer.

QUESTIONS.

Is the torpedo difficult of manufacture?

Not with proper plant.

Is great accuracy of manufacture necessary?

Yes, in certain parts of the mechanism.

Is great structural strength necessary?

No, except in the flask carrying the carbonic acid, where great strength is required.

What effect has the motion of the vessel at sea on the preparation of the torpedo and on the torpedo itself when in position for firing?

Not determined; no opportunity offered for doing so.

What effect has the motion of the ship on the facility of pointing?

Not demonstrated. In the case of this torpedo there could be none, as the pointing is done after the machine is launched.

eparation of the torpedo for action an elaborate process?
y elaborate.
is being handled, and when in position for service, are the vessel and her
nably safe from injury?
bly so at a long distance, but close aboard, at operating range, the measure
vould be exceedingly small. There would, of course, be great danger of
f either the torpedo charge or of the flask containing the carbonic-acid gas
ffect of the enemy's machine guns.
care necessary to keep the torpedo in a state for speedy use?
hours are required to charge the flask and get the torpedo ready for use,
once ready it remains so as long as desired within a limited time. A cruis-
ould need an ice machine, or other refrigerating or condensing apparatus,
charge the flask, and the preservation of the liquid acid in steel flasks for
of time would be attended with great danger to the vessel carrying it.
ctuating apparatus or material reasonably safe and harmless both when
l when in store?
phuric acid used in making the propelling gas must always be handled
care. To attempt to carry the flasks charged, as would be necessary in
r, would not be desirable, owing to great continuous strain on the flask,
f temperature, &c.
probably deteriorate or dangerously change with time or with the changes
ature and other conditions incident to service?
erials from which the carbonic acid is generated would not deteriorate.
torpedo be made innocuous automatically at the end of the flight?
ntor claims yes, and submits a plan which would probably be efficient, but
al tests were possible in the absence of any firing apparatus.
e conveniently and safely packed for transportation?
parts.
its price, with launching apparatus complete?
pany states its price as $10,000 for each torpedo. No apparatus for launch-
was presented.

POINTS CONSIDERED BY THE BOARD.

s torpedo cannot be safely and conveniently controlled and launched in a
th the apparatus supplied, the company itself declining to submit to such
es, through fear of injuring the torpedo.
as arranged to fire from a shield, port, or turret it could not be protected,
ing, from the fire of the machine guns of an enemy.
ourse could be seen as readily by an enemy as by those using it, and the
chine guns would be immediately and probably effectively concentrated
r its destruction.
propeller is not protected, and might readily foul itself with grass, sea-
oating nets, &c., so as to render its action ineffective.
he *mêlée* of battle the operating cables would be liable to displacement or
nd thus render the torpedo uncontrollable, and therefore useless.
t as compared with a well-known type of torpedo, the speed so far devel-
is torpedo is insufficient. Its speed not exceeding 15 statute miles or 13
hour, it could not overtake any vessel going at that speed, or even a slower
perly maneuvered to avoid it.
range of half a mile against an object at rest, though fair, could not be so
as against an enemy's vessel of even moderate speed, unless the enemy,
oss negligence, permitted the attacking vessel, armed with this torpedo, to
lf in a favorable position.
lnerability: This torpedo, moving at the surface at comparatively moder-
and necessarily at short range, is exposed to machine-gun fire, and a shot
ny portion of the torpedo would disable it, every section containing some

t should the expander be put in action, and meanwhile the emergencies
nterfere with the launching of the torpedo for a time, the speed of the tor-
d be very much reduced when finally launched.
ing a surface torpedo, the effect of its explosive action alongside an enemy
atical. In the opinion of the Board, a torpedo to be effective should be of
eous type.
at the action necessary in turning on the expander, as at present arranged,
defect in the machine, the Board being of the opinion that such action
automatic.
at from all previous experience and the experiments made in presence of

the Board with this type of torpedo, it sometimes fails, even after the most car adjustment, to operate properly, in the most unexpected and inexplicable man

13th. While the single experiment at Milford from the U. S. S. Speedwell, unde and at a speed of ten knots towards a target at anchor and in smooth water, was cessful, the Board is doubtful as to its behavior in even moderately rough water. immersion being small, the pitching motion under such conditions would be likely to throw both propeller and rudder out of water.

14th. While this torpedo embodies valuable features for harbor defense where it can be prepared and manipulated from the deck of a monitor or special vessel, Board does not consider that in its present development, and particularly as being surface torpedo, it is well adapted even to that purpose.

15th. A serious objection lies in the great length of time needed for filling the fl with the alternative of storing the latter, charged at an enormous pressure, and incurring the risk of explosion through the phenomenon known as the "fatigue of metals."

16th. One operator at least must be exposed, in order to watch the torpedo when dropped into the water from a vessel under way, nor can the engines of the torpedo be safely started until it is clear of the ship. Even then a mistake in steering the torpedo might be fatal to the vessel herself, while a failure to start promptly cause the torpedo to foul the ship's screw, with disastrous results.

17th. It would be necessary to have a reel of wire on board when firing from a vessel under way, or the topedo would be unmanageable. This would introduce a new source of accidents.

Finally, in view of these considerations and conclusions, the Board is of the opinion that this torpedo is not adapted to naval warfare.

Very respectfully, your obedient servants,

GEO. E. BELKNAP,
Captain, United States Navy, President of the Board.
E. O. MATTHEWS,
Captain, United States Navy, and Member.
C. F. GOODRICH,
Lieutenant-Commander, United States Navy, and Member.
H. E. NICHOLS,
Lieutenant-Commander, United States Navy, and Member.
A. R. COUDEN,
Lieutenant, United States Navy, and Member.

The undersigned, members of the Torpedo Board, were detached from duty therefrom on the 14th May, 1884, as described in the letter from the Navy Department of that date to the president of the Board, and hereto appended, marked K, and having witnessed the trials of the torpedo belonging to the American Torpedo Company at Milford, Conn., in February and May, 1884, do hereby concur in the findings and conclusions of the Board as declared in the foregoing report.

THEO. F. JEWELL,
Lieutenant-Commander, United States Navy, Member.
W. MAYNARD,
Lieutenant, United States Navy, Member.

THE WEEKS ROCKET TORPEDO.

Accuracy: Lacking.
Range: Insufficient and uncertain.
Velocity: Excellent, but very variable.

CERTAINTY OF OPERATION.

a. Certainty of launching and starting on its course: Good.

b. Certainty of explosion on contact with target: Undetermined by actual trial, but plans were presented for explosion on contact which would probably be efficient.

Destructiveness: Doubtful, as the efficiency of a surface torpedo as to destructive effect has yet to be shown by actual test.

Safety in handling: Measurably safe, but, as in the case of the torpedo presented by the American Torpedo Company, the safety of a torpedo may be regarded as an utterly unknown quantity in a naval combat.

ity in handling: Good, but it has considerable length, which may render it rd when the vessel has much motion.
icity: In design and construction it is very simple.
'y to be operated with safety from an enemy's fire: Fair; some exposure is lable, but when once prepared the operator can withdraw to a place of safety.
icity of launching apparatus: Good.
ency of launching apparatus: Good, so far as the mere operation of getting edo into the water is concerned.
ency as to launching at an object: Bad. As the launching apparatus is inca- f being trained, the pointing must be done by the helm of the vessel, which usually entail considerable difficulty and sacrifice of maneuver.

QUESTIONS.

torpedo difficult of manufacture?

at accuracy of manufacture necessary?

at structural strength necessary?

effect has the motion of the vessel at sea on the preparation of the torpedo the torpedo itself when in position for firing?
bly very little, but untried under such circumstances.
effect has the motion of the vessel on the facility of pointing?
tes adversely, as the pointing has to be done by the vessel itself.
preparation of the torpedo for action an elaborate process?

it is being handled, and when in position for service, are the vessel and her asonably safe from injury?
nably so, at a long distance, but close aboard at operating range the measure y would be small, as there would be danger of explosion of the charge by the machine guns.
ch care necessary to keep the torpedo in a state for speedy use?
little.
actuating apparatus or material reasonably safe and harmless, both when and when in store?

t probably deteriorate or dangerously change with time or with the changes erature and other conditions incident to service?
bly not.
e torpedo be made innocuous automatically at the end of the flight?
nventor claims yes—but as the plan involves the sinking or loss of the torpedo, ot tried.
be conveniently and safely packed for transportation?

is its probable price with launching apparatus complete?
ble cost of torpedo and launching apparatus, without explosive, $150, but r would only sell the right to manufacture and use.

POINTS CONSIDERED BY THE BOARD.

his torpedo possesses the advantages of simplicity, cheapness, and speed.
is fatally defective in accuracy.
s speed, at all times great, is very variable. This would seriously interfere ing for the change of position of a moving object or in firing across a current.
ts range is insufficient and very variable.
'he torpedo could not well be arranged for firing from a launching apparatus of train, owing to its great length and the possible effects upon the ship her- e products of combustion which are ejected from the rocket with great force the rear.
y, this torpedo is not, in the opinion of the Board, adapted to naval warfare.

OTHER EXHIBITS OF MR. WEEKS.

regard to the other models of floating and spar torpedoes brought before the r Mr. Weeks and described in Appendix G, the Board is of the opinion—
hat the floating torpedo is not a torpedo which would be of use in naval war-

2d. That the spar torpedo, of which a full-size model was exhibited and tried fore the Board, is, in fact, no better than the spar torpedoes already in use on b our ships of war, and they would, therefore, afford no fresh adaptation to the d of naval warfare.

Very respectfully, your obedient servants,

GEO. E. BELKNAP,
Captain, United States Navy, President of the Board.
E. O. MATTHEWS,
Captain, United States Navy, Member.
C. F. GOODRICH,
Lieutenant-Commander, United States Navy, Member.
H. E. NICHOLS,
Lieutenant-Commander, United States Navy, Member.
A. R. COUDEN,
Lieutenant, United States Navy, Member.

THE HOWELL TORPEDO.

Accuracy: Good.
Range: Fair.
Velocity: Moderate.

CERTAINTY OF OPERATION.

a. Certainty of launching and starting on its course: Good.
b. Certainty of explosive action on contact with target: Undetermined. system was presented.

Destructiveness: It is a subaqueous torpedo and would probably be effective.

Safety in handling: Measureably safe; but as in the case of the torpedo pres by the American Torpedo Company, the safety of a torpedo may be regarded a utterly unknown quantity in a naval combat.

Facility of handling: Good. The torpedo is very handy, being short and light.

Simplicity: Simple.

Ability to be operated with safety from an enemy's fire: Some exposure una able. Plans for a shelter were submitted which would probably prove satisfa

Simplicity of launching apparatus: Simple.

Efficiency of launching apparatus: Good; admits of rapid and easy training.

QUESTIONS.

Is the torpedo difficult of manufacture?
No.
Is great accuracy of manufacture necessary?
No.
Is great structural strength necessary?
No.
What effect has the motion of the vessel at sea on the preparation of the torpedo?
Probably very little.
What effect has the motion of the vessel at sea on the torpedo itself when in position for firing?
Not determined; probably very little.
What effect has the motion of the ship on the facility of pointing?
Less effect than on the pointing of a great gun, as the torpedo is easily trained, and elevation or depression are unimportant.
Is the preparation of the torpedo for action an elaborate process?
No.
While it is being handled, and when in position for service, are the vessel and her crew reasonably safe from injury?
Reasonably so at a long distance, but close aboard, at operating range, the measure of safety would be small, as there would be danger of explosion of the charge by the enemy's machine guns.
Is much care necessary to keep the torpedo in a state for speedy use?
Very little.
Is the actuating apparatus reasonably safe and harmless when loaded and when in store?
Yes.
Does it probably deteriorate or dangerously change with time or with the changes of temperature and other conditions incident to service?
No.

the torpedo be made innocuous automatically at the end of flight?
inventor claims yes, and submits plans which would probably prove efficient.
it be conveniently and safely packed for transportation?

at is its probable price with launching apparatus complete?
thousand dollars for one complete with launching apparatus.
he request of the inventor, the plan laid down for the experiments was—
To determine the effect of the "directive force" of the torpedo in securing ac- of flight in the horizontal plane, both from the vessel at anchor and when way at full speed.
To determine the uniformity of its submergence.
nd lastly. To determine its speed and range.
experiments were to be tried in all kinds of weather at sea.

POINTS CONSIDERED BY THE BOARD.

The horizontal accuracy due to the "directive force" was excellent with the o when fired from the vessel at anchor or under way and trained in various ions. The "directive force" inherent in this torpedo renders it unnecessary to any allowance for the torpedo's being deflected on striking the water, even when beam from a vessel moving at speed.
The uniformity of submergence was not determined, owing to the loss of the lo.
The speed as observed while making the experiments was not sufficient.
The extreme range observed was 1,500 feet, and the torpedo remained sub- d throughout the entire distance.
The launching apparatus is simple, easy of manipulation, and so arranged that be readily protected from the fire of machine guns.
Being a torpedo of the subaqueous type, its course cannot be seen by the enemy st whom it might be launched.
For the same reason its effect on striking a vessel at a proper depth would bly be fatal, even when carrying a moderate charge.
The propeller is fairly protected from fouling with sea-weed, floating nets, &c.
While simple and comparatively inexpensive in construction, of light weight adily stowed and handled, and showing great accuracy when launched against ct, this torpedo, though not now developed to a point adapting it to naval ., yet, in view of the good qualities which it seems to possess, the Board is of inion that opportunity should be afforded the inventor for further experiment. ally, this torpedo is not, in the opinion of the Board, adapted to naval warfare.
Very respectfully, your obedient servants,

GEO. E. BELKNAP,
Captain, U. S. N., President of the Board.
E. O. MATTHEWS,
Captain, United States Navy, Member.
C. F. GOODRICH,
Lieutenant-Commander, United States Navy, Member.
H. E. NICHOLS,
Lieutenant-Commander, United States Navy, Member.
A. R. CAUDEN,
Lieutenant, United States Navy, Member.

1. WILLIAM E. CHANDLER,
Secretary of the Navy, Washington, D. C.

176
1884

UNITED STATES NAVY YARD,
Norfolk, Va., August 23, 1884.

: Referring to the Department's letter of the 4th instant, a copy of which is ith appended, marked "1," directing the Torpedo Board to reconsider so much report of June 25 and July 11 as relates to the torpedo boat of Capt. J. A. How- nite l States Navy, in connection with his letter of July 19, addressed to the u of Ordnance, a copy of which is herewith appended, marked "2," I beg to in- the Department that at meetings of the Board at New York on the 18th and 19th it, careful reconsideration was given to the report in question, so far as relates Howell torpedo, the conclusions of which I have now the honor to transmit Department.

It will be observed that the signature of Lieut. Commander H. E. Nichols, United States Navy, is absent from their report, that officer having been detached from the Board and ordered to duty in the Pacific before any action looking toward reconsideration was had.

Very respectfully, your obedient servant,

GEO. E. BELKNAP,
Captain United States Navy, and President of Board.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy, Washington, D. C.

NEW YORK, *August* 19, 1884.

SIR: In reconsidering, so far as relates to the Howell torpedo, its report of the 25th June last, and which was transmitted to the Department on the 11th July, the Torpedo Board begs to remark, with reference to the letter of Captain Howell, U. S. N., addressed to the Chief of the Bureau of Ordnance July 19, that the record does not show that the programme of intended experiments was completed in any particular; it only shows what had been done in smooth water and at low speeds of the torpedo. The experiments were incomplete even under these conditions, as the trials for submergence, brought to an abrupt close by the loss of the torpedo, would have more crucially tested the quality of the machine as to directive accuracy than any trials that had gone before.

Captain Howell says, "The record shows that on the 12th trial the wake of the torpedo was seen for a great distance without its coming to the surface, showing that its path must have been very nearly horizontal, or the submergence must have been very uniform."

The record states that the torpedo itself could be seen, after once appearing at surface and just breaking the water at a short distance from the Speedwell, "to run at a depth of about four feet between the two boats, and about three hundred yards beyond before it came to the surface;" but the record further shows this running of the torpedo in a nearly horizontal path under the water was exceptional—that in no other instance was it observable—that, on the contrary, in several instances the path of the torpedo was so irregular and eccentric as to rise to the surface from one to nine times.

With regard to speed and the probable reserve of power to "produce a much higher speed" than was shown by the trials made, the Board could only report upon facts as adduced from actual performance; it could not base its report upon theory, no matter how correct the mathematical demonstration of the problem, nor how alluring its promises. No machine, as a matter of fact, ever works up to its extreme mathematically-calculated power. Higher speed might, indeed, be possibly accompanied by greater irregularities of submergence than were observed at low speed.

The clearest fact shown by the experiments, as detailed in the record, and as impressed upon the minds of the Board, was that, the torpedo in question did not show development to a point that promised certainty in its operations—the reasonable certainty that would be required in the varying conditions of naval warfare, whether as against an enemy at anchor in the smooth waters of a harbor or roadstead or as between ships, under the more trying phases that would generally obtain in a naval engagement at sea; a certainty that would warrant the Board in reporting a development so perfect and unquestioned as to recommend it as a machine so reliable and certain in the work demanded of it, as to require only duplication and multiplication to render it of such essential value to the naval service and the country as to warrant its purchase by the Government, under the terms of the act of Congress requiring the appointment of the Board and governing its action.

The instructions to the Board contain the following sentence:

"In its report (which is to be made to the Department) the Board will state distinctly whether, in its opinion, each torpedo examined is or is not adapted to warfare between ships at sea."

The effect of this sentence was to limit the Board to an expression of opinion as to the complete adaptability of any torpedo to naval warfare. However promising any invention might be, the Board was implicitly debarred from an estimate of its future value. As the experiments were confessedly incomplete, the deductions from them were, of necessity, restricted. No other conclusion than that given was or is possible.

The record shows that, on the thirteenth trial, the Howell torpedo was dropped in the usual manner and was lost—that, so far as could be seen, it never rose to the surface at all. At this trial the Speedwell was at anchor in seven fathoms of water, a fact accidentally omitted in the record.

In face of such a showing, and despite the several good qualities and valuable features the torpedo was seen to possess, giving promise of ultimate success in every

respect, the Board could not report that the torpedo was, within the meaning and intent of the law controlling its action, "adapted to naval warfare," especially in view of the fact that there are many shallow harbors and roadsteads in various parts of the world the naval forces of the United States might be called to operate in, where, under such a showing, the Howell torpedo exhibited to the Board would be non-effective.

The Board desires to correct its report by stating that a satisfactory firing pin was submitted.

Wherefore, the Board, while finding no occasion to change its views or to modify its report, except in the instances noted, desires to avail itself of this opportunity to state in stronger terms than its original instructions permitted, its belief that the Government would profit by affording material encouragement to the inventor.

Very respectfully, your obedient servants,

GEO. E. BELKNAP,
Captain, United States Navy, President of the Board.
E. O. MATTHEWS,
Captain, United States Navy, Member.
C. F. GOODRICH,
Lieutenant-Commander, United States Navy, Member.
A. R. COUDEN,
Lieutenant, United States Navy, Member.

Hon. WILLIAM E. CHANDLER,
Secretary of the Navy, Washington, D. C.

176/1884

NAVY DEPARTMENT,
Washington, August 4, 1884.

SIR: I herewith return to the Torpedo Board its report of July 11, 1884, in order that the Board may reconsider so much thereof as relates to the torpedo boat of Capt. J. A. Howell, U. S. N., in connection with his letter of July 19, 1884, addressed to the Chief of the Bureau of Ordnance, which is herewith transmitted.

Very respectfully,

ED. T. NICHOLS,
Acting Secretary of the Navy.

Capt. GEORGE E. BELKNAP, U. S. N.,
President Torpedo Board, Navy-Yard, Norfolk, Va.

176/1884

UNITED STATES NAVY-YARD,
Washington, D. C. July 19, 1884.

SIR: Referring to the report of the Torpedo Board on my torpedo, I think I am justified in charging that the finding is not in accordance with the body of the report. The record shows that the experiments were remarkably good, and that the proposed program was completed as to direction or accuracy; that regularity of submergence and extreme speed (being postponed) were not determined, owing to loss of torpedo but the record shows that on the twelfth trial the wake of the torpedo was seen for a great distance without its coming to the surface, showing that its path must have been very nearly horizontal, or the submergence must have been very uniform. The extreme speed was not shown, but it was evident that there was a great reserve of power and no reason why it should not produce a much higher speed, if it be legitimate to believe that one follows the other. I do not understand, therefore, how the Board could decide that my torpedo was not developed, since no experiments showed failure of design in any part. It is to be supposed that the points considered by the Board and the questions propounded cover the qualities of a torpedo adapted to naval warfare. None of these questions having been answered unfavorably, so far as my torpedo is concerned, and the experiments being favorable as far as they went, I am unable to understand by what reasoning the Board arrived at the conclusion that the torpedo is not adapted to naval warfare.

Very respectfully,

J. A. HOWELL,
Captain, U. S. Navy.

Capt. MONTGOMERY SICARD, U. S. N.
Chief of Bureau of Ordnance, Washington, D. C.

APPENDIX A.

ORDER APPOINTING BOARD.

NAVY DEPARTMENT,
Washington, November 24, 1

SIR: You are hereby appointed president of a Board for the investigation and in the United States of torpedoes adapted to naval warfare, and of the fixtures machinery for operating the same in accordance with act of Congress, approved M 3, 1883.

The following officers will be associated with you upon the Board for this Capt. E. O. Matthews, Lieut. Commander T. F. Jewell, Lieut. Washburn May Lieut. A. R. Couden.

Detailed instructions will be furnished you by the Bureau of Ordnance, and all persons applying to compete will be referred to you.

A suitable vessel from which to make the experiments will be provided, and after the receipt of the detailed instructions you will inform the Department at what time you will require her services.

You will convene the Board at such time and place as may be found advisable.

Very respectfully,

WILLIAM E. CHANDLER,
Secretary of the Navy.

Capt. GEORGE E. BELKNAP, U. S. N.,
Navy-Yard, Norfolk, Va.

UNITED STATES NAVY-YARD, NORFOLK, COMMANDANT'S OFFICE,
November 30, 1883.

Received and delivered.

W. K. MAYO, *Commodore.*

APPENDIX B.

INSTRUCTIONS TO BOARD BY THE BUREAU OF ORDNANCE.

BUREAU OF ORDNANCE, NAVY DEPARTMENT
Washington City, December 3,

SIR: At the last session of Congress an act was passed and approved March 3, from which the following is an extract:

"For the purchase and manufacture, after full investigation and test in the U States under the direction of the Secretary of the Navy, of torpedoes adapted to warfare, or of the right to manufacture the same, and for the fixtures and mach necessary for operating the same, one hundred thousand dollars: Provided, Th part of said money shall be expended for the purchase or manufacture of any torp or of the right to manufacture the same, until the same shall have been approve the Secretary of the Navy, after a favorable report to be made to him by a boar naval officers, to be created by him, to examine and test said torpedoes and in tions."

In pursuance of this act the Bureau (by direction of the Department) issued to prominent inventors and manufacturers the appended circular, marked A.

It will be perceived from an examination of the circular what meaning the Department attaches to the expression "torpedoes adapted to naval warfare," and this meaning must govern the Board in its proceedings.

It will also be seen that the Bureau did not undertake to inform inventors whether their torpedoes come up to the terms of the circular, but left that point to be decided by themselves in the first instance.

The undermentioned persons sent drawings to the Bureau, and signified th tions to present torpedoes before the Board when organized:

Mr. Asa Weeks.

The American Torpedo Company.

Commander J. A. Howell, U. S. N.

The Board having now been ordered, and informed that a vessel will be furnished from which to make the trials, the above-mentioned persons (and any others that may announce their desire to compete) will be directed by the Department to report to you with their apparatus; and you will observe that by the terms of the Bureau's circular a certain reasonable amount of labor will be furnished by the Department (if necessary) for erecting the apparatus on shipboard.

ng the qualities that should be possessed by a torpedo adapted to naval war- le following appear to be most essential:
uracy.
ge.
city.
ainty of operation.
ructiveness.
ty in handling.
lity of handling.
plicity.
lty to be operated with safety from an enemy's fire.
plicity and efficiency of the launching apparatus.

Bureau attaches very considerable importance to the last two of these qualities, ough a torpedo may be in itself adapted to naval warfare, if there is no prac- neans by which it could be efficiently, safely, and conveniently launched in the mportant different directions desirable in naval combat, this fact would detract reatly from its usefulness; and if it could not be held conveniently in the ing position at sea, or be conveniently pointed, or be sheltered properly from e of the enemy's great guns and machine guns until the ship that carries it arrive within working range, it would fall short in a very important respect ng an effective weapon.

ourse a torpedo not well covered, and even not very conveniently launched, be effectively used at night, in fogs, or in thick smoke, but for the general pur- of naval combat at sea it would be inadequate.

ng others the Board should note the following points:
le torpedo very difficult of manufacture, and is great accuracy of manufacture ary in order to obtain uniform results?
reat structural strength necessary?
at effect has the motion of the vessel at sea on the preparation of the torpedo, the torpedo itself when in position for firing, and what effect has the motion ship on facility of pointing?
he preparation of the torpedo for action an elaborate process, and while it is handled and when in position for service are the vessel and her crew reasonably om injury?
uch care necessary to keep the torpedo in a state for speedy use?
le actuating apparatus or material reasonably safe and harmless, both when and when in store, and does it probably deteriorate or dangerously change ime or with the changes of temperature and other conditions incident to service?
the torpedo be made innocuous (automatically) at the end of the flight?
it be conveniently and safely packed for transportation?
at is its probable price, with launching apparatus complete?

ough, owing to the diverse characteristics of the torpedoes that may be offered inspection of the Board, it is not possible for the Bureau to lay down any rigid or the conduct of the trial, the following programme is given as an example of would seem to be a systematic investigation into the behavior of torpedoes on trial as it is the intention of the Department to hold, and the Board is expected duct its investigations in as nearly similar a manner as the circumstances of ase will warrant, the object being to bring out clearly the advantages and dis- tages of each system that is admitted to trial.

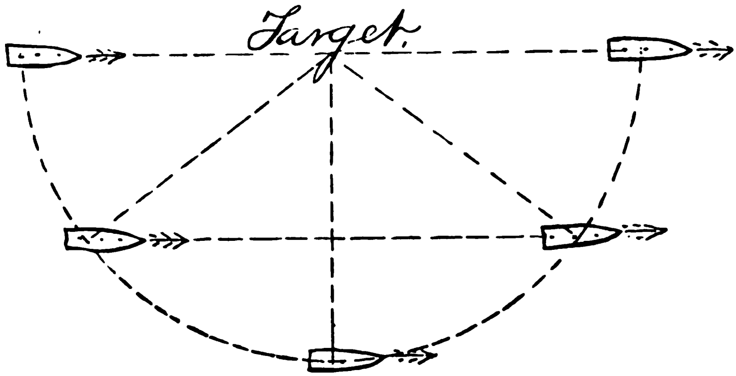
r an examination of the mechanical details of the torpedoes and the methods rying, loading, and launching them, the Board should proceed to the actual f those that they decide are adapted to use in warfare between ships at sea.

order that a correct idea may be formed of the character of the flight of each o, and also of the distance at which practice should take place in the sea trials, preliminary runs should be had in smooth water (against a target) either from ssel (held in a fixed position) or from a wharf, float, or other convenient place. his way, the readiness with which each torpedo starts, its most effective range, le time of flight to that and to shorter ranges can be ascertained.

rget should be employed at the longest range, and also at some of the shorter see page 6, paragraph 5), and boats and range sticks at right angles to the flight would be useful in marking the intervals of time on the trajectory.

ing thus obtained the absolute and comparative ranges, velocities, accuracy, nder perfectly favorable conditions, it would appear best next to ascertain (in h water, and without current) what deviations from the line of sight may be ed when the torpedoes are launched from a ship moving at speed past a fixed at the range which has been decided upon as the most effective for each torpedo. harges should thus be made at the target when bearing abeam, 4 points on the points on the quarter, and also when directly ahead and astern. It is consid-

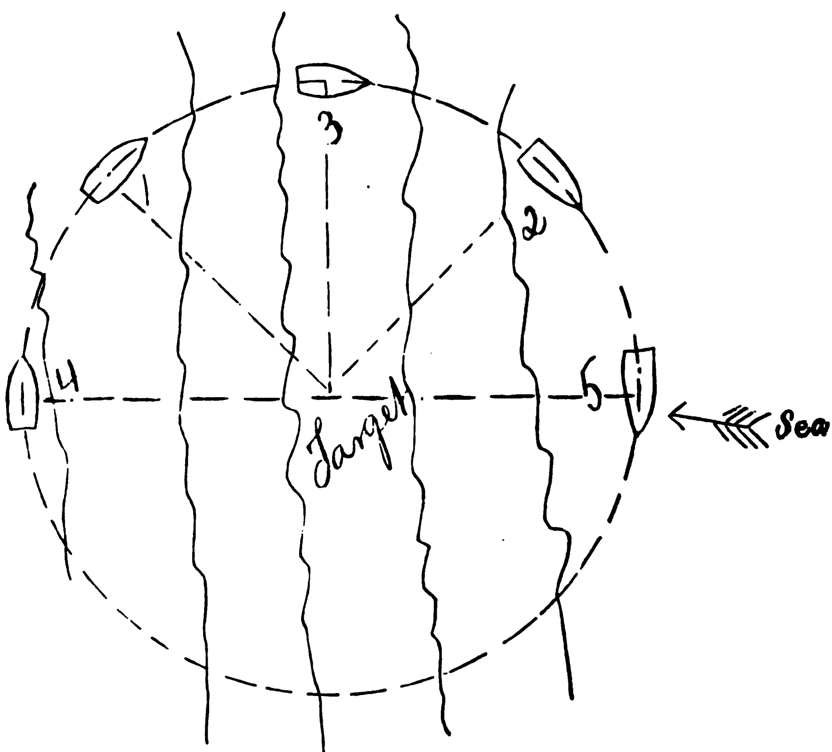
ered that these runs are stated above in the order of their importance and of the difficulty of successful execution. (See sketch.)



This experiment will probably bring out the deviations and errors of flight peculiar to each torpedo, unaffected by any other condition than the speed of the vessel. It is probable that information enough would thus be accumulated to enable the Board to proceed in an economical and efficient manner with the regular trials at sea, and these trials are the ones which are to finally determine the merits of the torpedoes.

The first point that it appears necessary to investigate is the effect of the sea on the flight of the torpedoes, and for this purpose positions should be selected from which runs towards a target could be made, having the sea 4 points on the bow and on the quarter (and also abeam) of the torpedo while running, as well as directly against and with the flight, the vessel and target to be both in a state of rest.

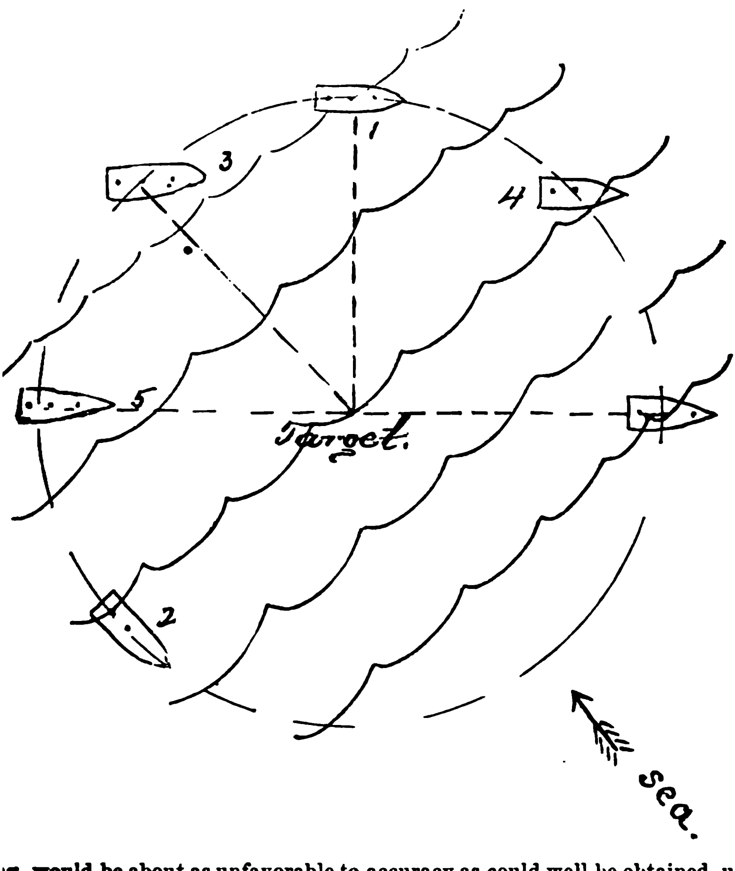
The annexed figures show five positions that seem suitable for this experiment. They are in the order of their apparent importance, and so numbered.



effect of the sea alone on the flight being thus recorded, it remains to ascertain viations due to launching the torpedoes in a sea-way from the vessel at speed t a target at rest, the object of this part of trial being to get such a direction as regards the line of the keel and the line of flight as will most clearly t the directive force of the torpedo and operate most to throw it from the ed line of flight.

iaps the position that would best accord with the above design would be when ig a ship with the sea 4 points on her bow, the torpedo being launched directly and on the side from which the sea comes.

s circumstanced, it appears probable that the deflective force of the sea running along the vessel's side and the movements of the ship herself, in rolling and



ig, would be about as unfavorable to accuracy as could well be obtained, unless g the ship directly head to sea and launching abeam should be found more rable.

: a sufficient number of runs have been made as above, the torpedo might be ed 4 points on the bow and then 4 points on the quarter of the ship, the angle ship's keel with the sea remaining about 4 points.

annexed sketch shows the several positions above described, which are numn the order of their apparent importance. Also 5 and 6, which are less difficult. e, are, no doubt, other positions from which valuable data could be obtained, any torpedo possesses any particularly distinguishing qualities (such as range d) this fact should be made to appear (by experiment) for what it is worth.

probable that a set of trials as nearly like the foregoing as the varying natures torpedoes will permit would bring out what value there may be in the several ns as sea torpedoes, and, in connection with such other experiments as the Board id it advisable to make, would afford data from which a conclusive report could wn.

It is very important to have a convenient target, and the following is suggested as likely to answer the purpose:

A line of suitable size, with wooden or cork floats at intervals, to which should be attached a muslin or net screen (the lower edge loaded with leaden weights) hanging down some 12 feet below the surface.

This could be kept stretched out in the sea trials by a boat or drag at one end.

The length of the target should be about 70 feet. This need only be used for the subaqueous torpedoes. Those that run on the surface might be run at the space between two barrels made fast to a line with the same interval. Those surface (or other) torpedoes that have detachable (or falling) magazines must be specially tested, in order to ascertain whether such magazines work certainly and properly.

It is of great importance to obtain the velocity and energy of the torpedoes at different points of the flight; and the striking energy at the working range is of essential importance, as it is a measure of the ability of the torpedo to break through defense nets, &c.

This last point must, if practicable, be determined by actual experiment, which may be made in smooth water if thought best. (It might be combined with the first trial.)

When the runs are made from the vessel at speed, it will be necessary to observe carefully the direction of flight, as that duty will then offer more difficulty than in the other experiments. This may perhaps be partly effected from aloft, or an observing boat may be stationed at the point where the discharge is to take place, or near the target. (See page 9, last paragraph.)

In the case of subaqueous torpedoes, both in smooth and in rough water, every effort must be made to ascertain whether they hold a constant depth of submersion, and to value such oscillations as may occur. This can best be ascertained by one or more muslin targets placed in the line of flight between the point of start and the final target.

The steadiness of flight must be carefully observed on all occasions.

The proprietors, or inventors, of the torpedoes on trial are to be allowed to embark on the vessel, and to be present at all trials of their own torpedoes. They will fully explain the theory and construction of their torpedoes, and will each manipulate his own (with the exception of pointing and discharge), with such manual assistance from the crew of the vessel as may be necessary.

They are, however, not to be allowed to decide as to the nature of the trials, nor as to the programme.

The description, size, and weight of each torpedo, and of its launching and preparatory apparatus, should be given. Also speed of vessel, height and direction of sea, wind, weather, &c., should be carefully noted.

In its report (which is to be made to the Department), the Board will state distinctly whether, in its opinion, each torpedo examined is or is not adapted to warfare between ships at sea.

It will also name those thus adapted (that it wishes to report favorably) in the order of their adaptation.

The Department desires it to be distinctly understood that every precaution must be taken to guard effectually the vessel and all those embarked in her against injury from the torpedoes and their appliances, and the Board will be especially careful to make all reasonable preparations for safety and to allow no person (civilian or otherwise) to expose himself to serious risk.

I am, sir, your obedient servant,

MONTGOMERY SICARD,
Chief of Bureau.

Capt. G. E. BELKNAP, U. S. N.,
President Torpedo Board.

APPENDIX C.

A.

BUREAU OF ORDNANCE, NAVY DEPARTMENT,
Washington City, July 12, 1883.

SIRS: In the naval appropriation bill for the year ending June 30, 1884, there appears under the head of "Torpedoes" the following item (see printed slip attached hereto).

You will observe that by the terms of the law the full investigation and test of the torpedoes must take place before a board of naval officers.

This board has not yet been appointed, but it is probable that it will be convened before October.

Supposing that your company may desire to present a torpedo with its necessary appliances before this board (for trial), the Bureau has thought it best to call your attention to the foregoing, and it will be happy to give you any other information concerning the matter that may be required.

be understood, however, that the law does not allow any of the money ap-
...ou for the purchase of torpedoes ($100,000) to be used in defraying the ex-
of the competitors, (such as freight, handling, removal, repairs, adjustments,
These must be paid by the parties presenting their torpedoes for trial.
...sel from which to launch the torpedoes would, however, be provided, and the
...r erecting the necessary launching apparatus on board of her would be fur-
by the Navy Department.
...will please observe that no torpedoes will be admitted to trial which are not
and practically adapted for use on board of a man-of-war at sea and in a naval
...ment.
...orpedoes presented must be in all respects of the pattern and size intended
...rvice" use on shipboard, and must be accompanied by the service, handling,
...nching apparatus complete.
...n consider any of your torpedoes adapted to naval warfare in the strict sense
...ed by this letter, and if you wish to present any of them for trial before the
you are requested to send notice to this Bureau as soon as convenient, inclos-
...ir drawings and descriptions of the torpedo and necessary apparatus for using
...ice.

...am, sirs, your obedient servant,

MONTGOMERY SICARD.
Chief of Bureau.

APPENDIX D.

NOTICE TO INVENTORS AND COMPETITORS.

Notice.

...tors and others who intend to bring before the Naval Torpedo Board torpe-
...apted to naval warfare, for examination and test, in accordance with the act
...gress approved March 3, 1883, concerning torpedoes, are hereby notified that
...rd will be in readiness to receive them at the navy-yard, Norfolk, Va., May
...l.
...tion is invited to the requirements embodied in the circular letter addressed
...etitors by the Bureau of Ordnance, Navy Department, July 12, 1883.

GEO. E. BELKNAP,
Captain, U. S. N., and President Torpedo Board, Navy-Yard, Norfolk, Va.

APPENDIX E.

NOTICE TO INVENTORS AND COMPETITORS.

Notice.

...tors and others who wish to appear before the Naval Torpedo Board with tor-
...adapted to naval warfare for examination and test, in accordance with the act
...gress approved March 3, 1883, concerning torpedoes, are hereby notified that
...rd will reconvene at the navy-yard, Norfolk, Va., June 20, 1884, in readiness
...ve them. Attention is invited to the requirements embodied in the circular
...ddressed to competitors by the Bureau of Ordnance, Navy Department, July
...l.

GEO. E. BELKNAP,
Captain, U. S. N., and President Torpedo Board, Navy-Yard, Norfolk, Va.

APPENDIX F.

...NDA OF TRIALS OF THE AMERICAN TORPEDO COMPANY'S TORPEDO, MADE BE- THE TORPEDO BOARD SINCE THE REPORT OF THE BOARD DATED MARCH 4, 1884.

...in trials were made and reported under date of March 4, 1884.
...oard met at Milford, Conn., May 13, at 11 a. m. Present, the President and
...members, Mr. Rowley, the representative of the American Torpedo Company
...lso present.

The Board was informed that the torpedo to be submitted for trial was the same as that tried before it in January last, a description of which, under date of March 4, 1881, is already on file in the Department; that the wedge-shaped bow has been replaced by one of cigar shape, and the length of the torpedo increased to 28 feet and 5 inches. A new electrical apparatus has also been substituted in place of the old one; in this the transmitter (in the boat) consists merely of two polarized relays, and the key-board of two pole-changing keys; the four functions "starboard," "port," "go," and "stop" only can be performed from the shore instrument. A double-core cable is used with this arrangement, and, as it has about double the area, the torpedo carries one-quarter mile of this instead of the one-half mile of the single core cable formerly carried. (See Appendix J.)

As a trial for speed was desired, watches were compared and a member of the Board stationed at the half-mile buoy and another at the quarter-mile buoy, with instructions to signal the arrival of the torpedo opposite their respective stations by lowering their flags. A third member was stationed at one side where he observed the time of passing each buoy. The time of passing the starting buoy was announced to the officers in the boats by lowering a flag on shore. The time of running the half mile, as determined by two members of the Board and by three civilians, was 2 minutes and 2 seconds, or 14.7 statute miles, 13.1 knots per hour.

The course had been laid off in the bay in front of the boat house, one-half mile long, with buoys marking each one-eighth mile. The certificate of Civil Engineer H. J. Kellogg of the correctness of these buoys is hereto appended, marked "I."

As it was impossible to prepare the torpedo for another trial before the tide would be too low to launch her, it was requested that she be brought off to the Speedwell in the morning at 10 o'clock for a trial from the vessel under way at a target.

At 11 a. m. of the 14th the torpedo was towed off to the vessel by a boat from the Speedwell and made fast astern. It was noticeably down by the stern on arrival. At 11.10 the owners arrived on board. There was a very light, choppy sea, and as the torpedo rolled she dipped her after flag-staff under water and allowed water to enter the expander compartment, and in a few minutes the torpedo sank stern first. This position of the torpedo mixed the acid and lime in the expander and gases formed, rushing out through the flag-staff, drove out the water, and the torpedo again floated on an even keel.

The torpedo was hoisted at a boat's davits, and the cover taken off the expander, the steering and engine compartments. It was found that it would be necessary to clean out and recharge the expander, and men were sent on shore for acid and lime, while others prepared the expander itself. At 4.15 p. m. got the Speedwell under way and steamed out into the sound, dropped and anchored two buoys to represent the extremes of a vessel, the space between them to be the target.

The torpedo was hung at a pair of the vessel's davits, on the starboard side, about 2 feet above the water, parallel to the vessel's keel, bow forward. The discharging apparatus consisted merely of two chains around the torpedo, one end of each sling being held in a goose-neck slip-hook; two tripping lines were used, one for each slip-hook. As the Speedwell was perfectly steady, the torpedo was easily held in this way.

The torpedo was run at the target under the following conditions: Speedwell running parallel to line of the target at a speed of 10 knots, the two lines about 300 yards apart, light breeze, force 3, two points on the starboard bow, sea smooth. The torpedo was dropped when the vessel had reached a point about 100 yards from the first buoy, and it was steered on a course nearly parallel to that of the vessel, until it was nearly abreast the first buoy, then given a port helm and it passed between the buoys, about 50 feet from the first buoy and making a curve half way around it.

The company not being prepared to go on with the further tests required under the more heroic conditions imposed by practice at sea, further experiment at this time was suspended; but on the 5th of June the board again convened at Milford, Conn., to witness a trial of the torpedo at night, to determine whether it could be efficiently steered under such circumstances.

Weather, bright moonlight; clear, calm, smooth sea. A member of the Board (Lieut. Commander Nichols) was sent out in a small boat to the half-mile buoy to observe the action of the torpedo and to note the time of arrival at or near the buoy. The time of starting was noted at the shore end by a member, and it was intended that the noted interval of time should give an approximate measure of the speed. The small boat displayed a light and was the target. On the guide rods of the torpedo were a red and white lantern, the red higher than the white and on the forward guide; the lights were intended to indicate the position and the heading of the torpedo. Everything being ready, the torpedo was discharged from the car. At the word "go" the engines were started, but it was soon noticeable that the torpedo was moving at not more than half its usual speed.

The president of the Board directed the steering of the boat, an employé of the company manipulating keys in obedience to his orders. The helm was first put to

board and the torpedo given a broad sheer away from the direction of the target. After going some distance the helm was shifted and the torpedo allowed to pass to right of the target, then again shifted to starboard and torpedo sent to the left of the target; again shifted and torpedo sent in direction of the target. The torpedo obeyed her helm slowly, corresponding to her reduced speed. The total distance run was about three-eighths of a mile in four minutes and thirty seconds.

The employés of the company explained the lack of speed as follows: The car should be run down the inclined railway and the tripping line should become taut just after the torpedo is water-borne, when the torpedo will be thrown clear of the still descending car. The length of the tripping line thus depends on the state of the tide. Owing to lack of experience in nightwork a mistake had been made, the tripping had taken place too early and the propeller had been injured by coming in contact with the iron frame of the car. When the torpedo was recovered and towed in it was found that one blade of the propeller had struck some hard substance. It was chipped slightly and its pitch lessened about three-sixteenths of an inch.

The Board is of the opinion that the slight injury done to the propeller in launching could not account for the great falling off in speed from former trials.

No further tests were made, the trial showing that the torpedo could be steered fairly well at night towards a fixed object, though the certainty of striking it would be questionable.

Appendix F.

CHANGES IN THE ELECTRICAL APPARATUS OF THE AMERICAN TORPEDO COMPANY'S TORPEDO SINCE THE REPORT OF THE BOARD DATED MARCH 4, 1884.

The cable now contains two conductors and is of twice the cross-section of the single conductor cable previously used with the "Haight" transmitter. One-half mile of cable is now carried and occupies the space formerly allowed to one mile. As the carbonic acid flask will only run the boat one-half mile the cable is still long enough for the boat; but the change is not an improvement, from the fact that the whole torpedo should be made shorter, if possible, and spaces and weights should be lessened, not increased. This change from a single conductor cable is made necessary by the changes in the electrical apparatus employed in the torpedo and on shore.

The present key-board (on shore) consists merely of two pole-changing keys, each key being in circuit with one of the conductors of the cable. In the boat the "Haight" transmitter or step-by-step apparatus is replaced by two polarized relays, one for each conductor. One pole-changing key, one conductor of the cable, and one polarized relay control the engine magnets; the second key, conductor, and relay control the steering magnets.

The action of the present apparatus will be readily understood by reference to the drawing hereto appended and marked A. In this are shown the key board complete, one polarized relay, and the engine magnets, together with the connections for "go" and "stop."

The action is as follows: Supposing the key over to position marked "stop," the current enters at post marked "carbon," thence to spring *a*, thence by rubbing contact *b* to post "line," thence by its conducting wire to post *c* of polarized relay, thence by *d* through magnet coils to *e*, thence by post *f* to *g*, thence through "stop magnet" coil to *h*; from *h* there are two paths to *m*, one, always closed, is through the "go magnet" coil; the other path is from *h* to *i*, thence through polarized armature *k* and through stop *l* (*k* and *l* have been brought into contact by the action of the current flowing through the coils of the relay) to *m*; from *m* by "earth" of the boat to "earth" of the key-board, thence to zinc of the battery.

As noted above, while sending a current through the stop magnet, a current is also sent through the go magnet. The whole current, however, goes through the stop magnet, while only a portion goes through the other; the current dividing between two paths inversely as the resistance, it follows, since the resistance of the go magnet is very large in comparison with the resistance of the other path, through armature of the polarized relay, that the current in the go-magnet coils is very feeble and has little effect toward preventing the prompt action of the stop magnet.

If the key were reversed, that is, thrown over to position marked "go," it will be seen that the current will be reversed, the polarized armature *k* will be thrown into contact with *x*, and the current through the go magnet will now be strong and that through the stop magnet weak.

As only four functions are provided for in this apparatus, the torpedo cannot be fired at will. The firing being by electricity on contact, a battery in the boat is required for the necessary current. The drawing marked B, hereto appended, shows the arrangement proposed. It will be seen that the circuit is broken in two places, between *a* and *b* and between *c* and *d*. The break between *c* and *d* is closed only while

the engine is running; a pipe *f* leading from the gas pipe near the engine allow gas pressure to push the piston *e* into contact with them during the time the valve is open and the gas unexhausted. The break between *a* and *b* is clos... ever there is sufficient pressure on the plunger leading through the nose of pedo. The object of the break, which is closed by the gas pressure, is to re... torpedo innocuous, when, having missed the target fired at, it may be floating a... and become (without some such safeguard) dangerous to friend or foe.

The presence of a local battery in the boat, while not a serious objection, r... a certain amount of attention and periodical inspection, which would be avo... the firing were done by the battery used for controlling the movements of the t...

APPENDIX G.

DESCRIPTION OF THE TORPEDOES PRESENTED BY MR. WEEKS FOR TRIAL THE TORPEDO BOARD.

The rocket torpedoes presented by Mr. Weeks for trial before the Board w... in number. (A fifth was presented later. See latter part of this paper.) ... eral design of three of them was the same, the fourth was different, principally ... fact that it was arranged for using two rockets while the others used but one.

The drawing, hereto appended and marked C, shows the type in which ... rocket is used; also the discharging or launching apparatus. The torpedo i... heavy tin plate, strengthened and stiffened with wood.

Referring to the letters on the drawing, A represents the explosive ch... signed to contain not less than seventy-five pounds of dynamite or other ... material of the same specific gravity. B is a hollow chamber intended to give ... ancy to the bow and prevent diving. A cross-section through the bows, would ... flat ellipse, drawn to a sharp angle above and below, terminating in a plate. ... sharp plate is intended to cut through nets or similar obstructions. C rep... the loading holes. D D are metal slings which slip over the arms G of the lau... ing apparatus. H is a portion of the launching apparatus which projects to the ... and to which is made fast the cotton yarn lanyard I. This lanyard is also made ... to the torpedo and holds it on the davits, until it is burned away by the gases ... the ignited rocket. J J are the stern rods or steering tails. These are of wood ... a triangular piece of thin sheet iron at the after end as shown at O. One of ... torpedoes had, in addition to the triangular piece of iron, an iron skag runni... whole length of the tails, as shown in the drawing. At K is shown the ele... connections for discharging the torpedo from its davits, by igniting the ro... water cap and gland of the service torpedo pattern is used with servic... and a Farmer's A or C machine. L is the firing device, shown full size ... cocked position. M is the safety cap which covers the end of the firing p..., ... not removed until the torpedo is hung at the davits and ready for use. N is ... rangement designed to be screwed into position after the safety cap is removed: ... is intended to be used against nets. When in position pressure against any ... the blade will force the firing pin and release the trigger.

The construction and operation of the launching apparatus will be readily understood from the drawing. The section on C-D shows the torpedo in a recess ... vessel's side, where it is protected from fore and aft fire.

To prepare the torpedo for firing, it is only necessary to swing the davits ... lower away by the slings P until the torpedo is in a suitable position. The ... is supposed, at all times, to lie parallel to the keel of the vessel.

In the drawing hereto appended and marked D is shown the torpedo designed for carrying two propelling rockets. One rocket is first to be ignited, and when it is nearly burned out the flame is to be carried, by means of a bent copper tube, as shown, to the second rocket. The object sought is increase of range.

The torpedoes tried were of the following general dimensions:

No. 1. Total length 33 feet, width 9 inches, depth 12 inches, weight 426 pounds.
No. 2. Total length 28 feet, width 12 inches, depth 11 inches, weight 401 pounds.
No. 3. Total length 37 feet, width 12 inches, depth 11 inches, weight 529 pounds.
No. 4. Total length 27.5 feet, width 11 inches, depth 18 inches, weight 597 pou...

The weight of the launching apparatus is 560 pounds.

The rockets are 6 inches in diameter and three and a half feet long, and weigh with the inclosing iron case 110 pounds. They are bored nearly their whole length, in a line parallel to, but at one side of, the central axis. Mr. Weeks claims that by this boring he keeps a more uniform burning surface, and, consequently, a more uniform pressure than would be obtained if the boring were central. The burning surface increases until the iron case is reached, then, while the radius of the burning cylindrical surface increases, more iron is uncovered, and a decreasing portion of the cylinder is of rocket composition.

This may be more clearly understood by considering a cross-section of the burning surface at different stages of the action; originally the cross-section is a circle, and so continues until the iron case is reached when it ceases to be a complete circle. As the radius increases the arc of the circle (angular) derceases.

On June 24 Mr. Weeks submitted a new torpedo, differing slightly from those above described, and of which a drawing is hereto appended, marked E.

MEMORANDA OF TRIALS OF MR. WEEKS' TORPEDOES, MADE BEFORE THE TORPEDO BOARD.

The Board met May 21, at the navy-yard, Norfolk, Va. May 22, at 7.30 a. m., the Board, with Mr. Weeks and his torpedoes, Mr. Thompson (leading man) and Mr. Benham (first-class ordnance man), from the Washington navy-yard, being on board. The Speedwell got under way and steamed up to Yorktown and made fast to the wharf at that place. During the passage Mr. Weeks exhibited his torpedoes and models to the Board and explained their action and mode of operation.

First trial.—The Speedwell lay heading up the river. Attempted to lay out a course marked by buoys; the buoys to be 150 feet apart, and the course 750 feet long (the range as estimated by Mr. Weeks). The tide was too strong, however, and it was found impossible to make the buoys watch accurately. For this reason a range was laid off on the beach parallel to the course, and range stakes were so placed that the time the torpedo passed each 150 feet of the range could be determined. The torpedo was prepared in about ten minutes, everything having been laid out beforehand. Observers were stationed at each range to note time. A service D E igniter placed in the rocket orifice was fired by a Farmer's C machine; the torpedo hung at the davits for one and a half or two seconds, then started off at a high velocity, giving off great clouds of smoke. It ran about 470 feet, sheering broadly to the right. The velocity was not accurately taken (the different watches not running well together, and the intervals being very short); it approximated, however, to 75 feet per second, or 45 knots per hour. The direction of the torpedo was readily determined by the observers on board the vessel, the torpedo being pointed parallel to the keel and ahead. The water was smooth, the wind was very light, and wind and tide were directly with the torpedo.

Second trial.—A second was prepared, in which two rockets were used; these were placed one above the other; the D E igniter was in the upper one, and the intention was that when the first rocket was nearly burned out, the flame from it should be led from it to the lower and second rocket by means of a bent copper tube. Observers having been stationed as before, the torpedo was fired, and hanging at the davits about as in the previous trial, went off, and, maintaining a straight course, ran a distance of about 825 feet, the speed being approximately the same as before. The torpedo perceptibly slackened speed at about 400 feet, and an instant afterward the second rocket commenced burning, when the torpedo sprang forward with sudden acceleration. The conditions of wind and tide and sea were the same as before.

Third trial.—A single rocket torpedo was used in this trial. The conditions were the same as before in all other respects. The torpedo ran about 500 feet, sheering to the left during latter part of run. The speed about the same. In these trials the torpedo was just awash in the davits.

Fourth trial.—On May 23 the Speedwell was run down outside the capes of the Chesapeake to find a sea in which to try the torpedoes with the vessel underway in rough water and firing at a target. The sea being smooth, and with no prospect of a change, at 3.30 p. m. ran inside, and into Lynn Haven Bay, to try a torpedo at a target in smooth water with the vessel at speed. Anchored a buoy to serve as a target. Wind about 3, smooth sea with a light ripple, ship going about 9 knots, torpedo on starboard side pointed in line with the keel (the only method as fitted at the time), and ahead, wind and ripple about 2 points forward of port beam, target about 800 feet ahead. Mr. Weeks' largest torpedo (not the double rocket one) was used. The torpedo on being fired had a drop of about 2 feet into the water; it went straight 25 or 30 feet till just abreast the bow of the vessel, when it went at an angle of 30 or 40 degrees, sheering rapidly to the right, until rocket was exhausted. It ran a distance of about 300 feet. The curve was to leeward.

The Speedwell returned to the navy-yard to have the discharging apparatus rigged over the stern, so as to be able to fire the torpedo abeam of the vessel at sea.

Fifth Trial.—The discharging apparatus was shifted to the stern of the Speedwell, and so placed that a torpedo would point at right angles to the keel (or abeam) and to starboard. May 26, at 6.30 a. m., got under way and steamed down to the Capes for further trials from the vessel under way. Found the sea perfectly smooth, but determined to make a smooth water trial pointing abeam. Rigged the torpedo intended for two rockets; the upper space was occupied by an empty rocket case and

the lower space contained the single rocket intended to be used. To deter[illegible] range and accuracy, a buoy was dropped for a target and two members of th[illegible] were stationed in a boat to act as observers. The Speedwell was run at full (about ten knots) on a course at right angles to a line joining the anchored b[illegible] buoy and between the two, and at an estimated distance from the buoy [illegible] feet. At 11.30 a. m. the buoy bearing abeam, the word "fire!" was given, second buoy and anchor dropped. A member of the Board stationed at the [illegible] (15 feet forward of the torpedo) observed that the buoy bore abeam at the [illegible] of firing; the word had been given an instant before to allow for manipulati[illegible] the D. E. machine, and for the time the torpedo requires to get up motion. The wi[illegible] force 2, was one point on port bow; the sea was perfectly smooth. From the ves[illegible] the torpedo appeared to deflect to the right, or leeward. The members of the Boa[illegible] in the boat, who were in the prolongation of the line of sight, reported that the t[illegible]pedo took a broad sheer to the right, at an angle of 45 degrees, and missed the t[illegible] by 250 to 300 feet to the right, and that it ran about the distance between the [illegible] anchored buoys. This distance was found twice the Speedwell's length, or [illegible] feet.

Sixth Trial.—May 27, at 1 p. m., got under way and steamed down to the [illegible] Found the wind, force 3, ESE., and the sea smooth with a light chop. The [illegible] charging apparatus had been shifted to the starboard beam, and a torpedo had shipped parallel to the keel and pointing aft. With the vessel going about [illegible] (16.6 feet per second), wind on the starboard beam, dropped a buoy, and abo[illegible] seconds afterward gave the order to fire, and dropped a second buoy. The dis[illegible] was approximately 425 feet. The torpedo after leaving the vessel first took a [illegible] to the right (or leeward) and then a rank sheer to the left, and finally stopped a [illegible] short of and to the left of the target.

Seventh Trial.—Shifted the rods in the discharging apparatus so that the t[illegible] should point ahead and parallel to the keel. Prepared the torpedo intended for [illegible] rockets, placing an empty case in the upper space and a rocket in the lower s[illegible] At 3.30 p. m., wind force 3, and four points on the starboard bow, sea smooth, [illegible] light chop as before, ship going ahead about 10 knots, the word "fire" was given. [illegible] torpedo on striking the water turned over on its side; it, however, soon righted [illegible]self. From the start it took a rank sheer to starboard (windward) of 45 de[illegible] or more. The intervals from the word "fire" to the end of the torpedo's [illegible] and from the word "fire" until the vessel arrived abreast the torpedo itself, [illegible] taken. The torpedo was 11 seconds under way, and the vessel required 30 seconds [illegible] arrive abreast it. This latter would indicate a range of 625 feet approximately.

Eighth Trial.—Prepared the same torpedo in the same way, except that the up[illegible] space was left entirely empty. Wind, force 3, ahead, sea smooth with light rip[illegible] Ship going ahead about 10 knots; at 3.45 p. m. fired the torpedo, noting interval[illegible] before. Torpedo went fairly straight for one-half its run, and then took a rank s[illegible] to starboard. Range was about 480 feet. The rocket burned 9 seconds.

Mr. Weeks explained to the Board that the last two trials were with rockets [illegible] some months before (four or five), and were imperfect in that some of the gas [illegible] likely to escape about the head through screw holes, instead of all passing thro[illegible] the orifice. He exhibited the last case used and it was evident that gas had esca[illegible] from the screw holes on one side. Mr. Thompson (leading man from Ordnance [illegible]partment, Washington navy-yard) informed the Board that this difficulty had occur[illegible]red in one of the rockets used on the first day's trials at Yorktown, although it was of the most recent type. Mr. Weeks had stated that this had been overcome by im[illegible]proved methods of manufacture.

June 24 the Speedwell, with the Board, proceeded to Newport News and anchored near the beach and about one-half mile above the railroad wharves, for the fi[illegible] trial of Mr. Weeks's torpedo. The torpedo presented by him on this occasion dif[illegible] but slightly from those previously tried, a drawing, hereto appended and marke[illegible] represents this type.

Ninth trial.—Vessel at anchor riding to the ebb tide. Tide running one knot. Wind, force 2, on port quarter. Sea smooth. Torpedo pointing ahead and rigged on the starboard side. Three members of the Board were stationed on the shore to ob[illegible]serve the range and speed. Stakes were set up along the beach, parallel to the c[illegible] of the torpedo, at distances of 200 feet from each other, in a manner similar to [illegible] adopted at Yorktown on May 22. On firing, the torpedo took a sheer to port, [illegible]ing the bow close to the vessel, making an angle of about 30 degrees. Range [illegible] feet. Time occupied 8 seconds. Speed, 28.8 knots.

Tenth trial.—Vessel at anchor. Tide, wind, and sea, the same as above. Sh[illegible] discharging apparatus so as to fire directly astern. On firing, the torpedo ran [illegible] about 200 feet, then took a sheer of about 30 degrees to the left. Range [illegible] Time occupied in running 340 feet was 9 seconds, indicating a speed of 22.8 kno[illegible]

Steamed down between capes to try the torpedo in a seaway.

Eleventh trial.—Vessel not anchored, but with the engines stopped. Wind, force 3,

beam. Very moderate chop sea. Target was a floating breaker, right ahead. ıg, the torpedo took a sinuous course, but the resultant direction was straight. ted range, 400 feet.

informed the Board that he considered further trials useless at present.

, the president of the Board and Lieutenant-Commander Nichols, and Lieuonden, members, were present at the following experiments at the Washington Yard.

Trial.—Sea smooth, light airs; tide, last of the flood and against the course edo, vessel at the wharf. On firing, the torpedo hung at the davits about s. Range, 450 feet. Torpedo took a sheer of 20 degrees to the left. The urned 10.8 seconds.

enth *Trial.*—The same conditions. Used a rocket made in January, 1883. On the torpedo hung at the davits about 1¼ seconds. The range was about 500 The torpedo took a sheer of about 20 degrees to the left. The rocket burned onds.

MR. WEEKS' FLOATING TORPEDO.

Weeks exhibited before the Board, a very small model of his floating torpedo. are intended to be dropped overboard in numbers from a vessel being pursued. emy's vessel on striking them is supposed to fire them by contact with her own This torpedo is fully described in U. S. Patent No. 274069.

MR. WEEKS' SPAR TORPEDO.

Weeks also exhibted before the Board, a spar torpedo. This torpedo is fully ed in U. S. Patent No. 273413. In this, the spar is supposed to project forward ıtally above the surface of the water. The torpedo is held in a hollow sleeve, prolongation of the spar, by a projecting pin at the after end and a spring at the forward end. Projecting forward of all is a bow-shaped trigger, which g against a vessel's side drops the torpedo. Attached to a firing-pin in the rear the torpedo is a line; the other end of this line is made fast to the forward end hollow sleeve. The action of the torpedo is claimed by Mr. Weeks to be as s: When the trigger is sprung, by striking a vessel's side, the torpedo falls downnd forward, going alongside of and under the enemy, and explodes when the omes taut.

torpedo was tried several times; when the vessel was going ahead fast the torll vertically until it struck the water, when it trailed aft, and, by the time the s taut, it trailed aft about 45 degrees; when the vessel was stopped the torell below its heel, around which it hinges when coming out of the sleeve. se trials the spar was rigged parallel to the vessel's side and the trigger was by a line. The torpedo was shaped like an ordinary elongated shell, the diam- the cylindrical portion was 5.5 inches, the length of the cylinder was 23.5 the length of the ogival head was 6.5 inches, the total length was 30 inches. e was 8 feet long.

APPENDIX H.

PTION OF THE TORPEDO PRESENTED BY CAPT. J. A. HOWELL, U. S. N., FOR TRIAL BEFORE THE TORPEDO BOARD.

orpedo presented by Captain Howell for trial is shown in the drawings heretoed—two sheets.

torpedo is cigar-shaped, pointed at both ends, and is made up of four principal tments. The bow or head is ogival-shaped, and is to contain the explosive, er with the firing-pin, etc. The diameter of the base of the ogival is 13 inches. gine compartment is, in general shape, a cylinder and contains a large fly-wheel o pairs of miters for transmitting the motion of the fly-wheel to two propellers, ed as twin-screws. This cylinder is 13 inches in diameter, except abreast the the fly-wheel, where it was, by hammering, bulged to accommodate the diam- the fly-wheel (13.5 inches). To the rear of the engine compartment is a secgival, the greater part of which is unoccupied. This unoccupied portion is to the water The after end of this ogival, however, is open to the water and s the steering and the depth-regulating apparatus, both automatic.

rring to the letters on the drawings, G is the torpedo, L the head or explosive rtment, M the engine compartment, and O the rear ogival containing at its after steering and diving apparatus. H H are the steering rudders. I I are the pro- K is the diving-rudder. The actuating and discharging apparatus used durtrials is shown on sheet I. A is a steam-pipe leading from the boilers and con-

veying steam pressure to a Barker's engine, B. P is an angle-iron which carrie saddle, C. This saddle fits over the torpedo and holds it in place by clutching a jecting stud. The drawing is incomplete, in that, the angle-iron, P, extended be the nose of the torpedo, and from its end hung a pair of straps and stirrups. stirrups hooked over studs, one on each side of the torpedo, about midway of its len The straps were horizontal when the torpedo was in the saddle, and the stirrups so shaped that they released their hold of the studs whenever the straps became v tical. E is a counterpoise weight which keeps the torpedo on an even keel until it discharged. This is automatic and allows for any pitching or rolling of the ves The discharging apparatus can be readily trained by one man, from nearly ahead nearly astern, swinging about F as a pivot.

The motive power of this torpedo is energy that is stored up in the fly-wheel a it has acquired a high velocity. The fly-wheel weighs 108 pounds and has a ra of gyration of 5.4 inches. With a velocity of 170 revolutions per second the en would be, approximately, 345,000 foot-pounds; with a velocity of 200 revolutions minute, the energy would be more than 475,000 foot-pounds. As the torpedo wei 299 pounds only, and has a fair form, this energy applied through efficient scr ought to give a high speed for a range of 2,500 feet. The automatic steering appar is founded on the principle of component axes of rotation. The plane of the fly-w is vertical, and in the longitudinal axis of the torpedo; its axis of rotation lies in horizontal plane. Now, when the fly has a high velocity, any force which tend sheer the torpedo is resolved into a rolling motion about the longitudinal axis of motion torpedo and a of translation of the whole system (that is, the torpedo it in a direction perpendicular to the longitudinal axis of the torpedo; that is, the sult of a deflecting force is to roll the torpedo and move it parallel to itself.

When the torpedo experiences a deflecting force, and is, in consequence, rolled o to one side, the steering rudders H H are thrown into action in such a way a exert a deflecting force in the opposite direction until the torpedo is again on an e keel, and the only effect on the torpedo is to move it bodily to the right or l the course. If the torpedo originally headed south, it would head south durin the movements detailed above. This is the theory of the automatic steering w renders it unnecessary to make any allowance for deflection due to the torpedo's ing the water at any angle when fired from the broadside of a vessel under way at sp The automatic apparatus for keeping the torpedo at a constant depth is a simple trivance for actuating the diving-rudder K.

The manipulation of the torpedo is as follows: The torpedo being in the gang and the discharging apparatus swung over it, the torpedo is hoisted into the sad and the clutch hooked over its stud, the stirrups being at the same time hooked o their studs. This operation was, without previous warning, performed in 1 and 50 seconds. The Barker engine is connected by an automatic spring-c the axle of the fly-wheel, and steam being turned, through the steam-pipe A, onto motion is given to the fly-wheel which soon becomes very rapid. When the velo has become great enough, the steam is shut off and the engine is disconnected l tripping-line; the torpedo is now ready to fire. On the trigger being pulled the clutch lets go and the torpedo falls, and by its weight is thrown forward and ward in the stirrups, and leaves the latter with a velocity of 16 feet per second (knots). The torpedo can be trained while the steam is on, and the steam can be on till the instant of firing. With 40 pounds of steam the engine was usually on about one minute; with a higher pressure a shorter time would suffice.

The length of the torpedo is 8 feet; its greatest diameter is 14 inches; its wei is 299 pounds; its weight allowance for explosive is 70 pounds.

For use in practice, it is buoyant; for service, it would be arranged to sink at end of the run, in case of missing the object.

The inventor submits a plan, sheet 2 of drawing, for protecting the torpedo small arm and machine-gun fire when it is in a position ready for firing. This or cover is shown in red, and fitted to a non-training broadside-discharging appa

MEMORANDA OF TRIALS OF CAPT. J. A. HOWELL'S TORPEDO, MADE BEFORE TORPEDO BOARD.

May 29, 1884, the Board met at the Washington navy-yard for preliminary tri Captain Howell's torpedo.

First trial.—The torpedo, with the discharging apparatus, was on board the t Rescue at a wharf in the yard (wharf on which the sheers stand). At 3.45 p. m. t torpedo was ready for a trial across the channel, here about 300 feet wide. The e tide was running about 1½ knots. The torpedo was fired at right angles to the ke and dropped from a point about 4 feet above the water. Steam (40 pounds) was on the motor 20 seconds. Depth of water alongside, 18 feet. The torpedo, on being fired, disappeared beneath the surface, and was afterward found to have stuck in the mud in 15 feet of water. In this and the next four succeeding trials a small cork buoy with several fathoms of light twine was attached to the torpedo, in order to recover it in case it remained below the surface. Sea smooth; no wind.

nd trial.—All the conditions were the same except that the torpedo was pointed angle with the keel (45 degrees) up-stream and against the tide. It was aimed corner of a scow lying on the banks, about 800 feet distant. The torpedo, on ired, went under the water, but soon reappeared like a porpoise coming up to , immediately disappearing again beneath the surface. It rose in this manner e times, and by these appearances the course could be readily observed. Finally, torpedo stuck in the mud in 3 feet of water, near the object aimed at. The tor- had sagged a few feet down stream and tide from the course, but was at its last nce apparently parallel to the original course.

in Howell then briefly explained the mechanism and principles of his torpedo unching apparatus to the Board.

y 31, the Board met at the Washington navy-yard, Captain Matthews absent . Captain Howell, previous to the arrival of the Board, had fired his torpedo, it had remained below the surface, together with the cork buoy. At 1 p. m., the edo not having been recovered, the president of the Board detailed Lieutenant n (a member of the Board) to remain at the yard and witness and report any ments that the inventor might desire, in case he recovered the torpedo. The edo having been recovered, the inventor prepared to make trials to exhibit initial d (first 100 feet), range and direction from a vessel in smooth water at rest.

ird trial.—The Rescue at the entrance of the western ship-house; the torpedo pointed down-stream on a line passing through prominent points on the shore. tide was running a moderate ebb. To determine the speed, a line 100 feet long attached to the buoy and the time occupied in running out this length was marked neans of a stop chronometer belonging to the Ordnance Department.

determine range, the point at which the torpedo stopped was located by eye reference to surrounding landmarks and the distance laid off on a chart (scale, 100 equal to 1 inch). The wharves, which have not been changed since the chart was e, and nearly parallel to the ends of which the torpedo's course lay, enabled distance to be quite accurately measured. To determine direction, the torpedo pointed on a readily recognized course, and its position each time it came to the ace with its final position gave a fair method of determination. Steam was on or 40 seconds; pressure, 40 pounds. Speed, 100 feet in 6.6 seconds, or 9 knots. torpedo rose several times and the direction appeared to be straight, but the final tion showed that the torpedo had stopped about 15 feet to the left of the course. range was not less than 1,000 feet. The chronometer was in the hands of Mr. son (leading man, ordnance department, Washington navy-yard); the line was ut no faster than the torpedo would take it. The point at which the torpedo ped was determined by Lieutenant Couden going to the torpedo in a boat immeely after it had stopped and stuck at the bottom. All points were under the imiate observation of the member of the Board present.

urth trial.—Another trial was made with no change in the conditions, except that was on the motor one minute. The results were the same as before, except the 0 feet was 9.37 knots. The distance of the final position from the line of the se was not determined, but was about the same as before, not greater. The tor- rose to the surface nine times during this run.

fth trial.—This trial was for direction when fired from the vessel under way. For purpose the Rescue proceeded down the river to a point opposite Alexandria t-house. Lieutenant Couden then embarked in a small boat and made fast to a . The Rescue, passing down stream, turned about and ran up-stream at full d, estimated at 10 knots, and fired the torpedo abeam when abreast the boat. At instant of firing, the boat was cast off from the buoy, so that the torpedo and the rver might be subject to the same tidal influences. The torpedo was fired directly s the tide, and as it came to the surface several times, its course could be well rved. The course was straight, and the range, by estimation, was 800 feet. tain Howell stated that on this trial steam was on the motor 53 seconds; pressure, ounds; and that the torpedo was fired 30 seconds after the steam was cut off.

e Board met at the Norfolk navy-yard June 20, for further trials of Captain ell's torpedo.

ith the Speedwell, proceeded to Newport News and anchored in 6 fathoms of er about one-half mile above the railroad company's wharves. Two buoys were ored inshore in 17 feet of water as a target; the buoys were connected by a line eet in length. The line was fairly taut. The vessel was riding to the ebb-tide the target was four points abaft the starboard beam. The discharging apparatus on the starboard side, abreast the steam-drum. The discharging apparatus has in from nearly ahead to nearly astern.

th trial.—Vessel at anchor; sea smooth; wind force 2 on starboard beam; tide ing ebb 1 knot; steam on motor 40 seconds; pressure, 40 pounds. The cork buoy line were not used on this and subsequent trials. The torpedo was trained on a t about 100 feet to the left of the left buoy to allow for tide, the vessel and target g at anchor. Fired the torpedo at 2.13 p. m.; it immediately disappeared beneath

the surface, and was first seen from the vessel 2 minutes and 10 seconds later. It appeared with its propellers above water and dove perpendicularly. Lieuts.. Commanders Goodrich and Nichols (members of the Board) were in two bo tioned near the target to observe the action of the torpedo and the point of e range. They reported that the torpedo had barely shown itself once before th when its propellers came above water, but at nearly the same point. As to dire the torpedo was on its first appearance about 40 feet to the left of the left buoy. to range, a boat was anchored at or near the point where the torpedo was served, and a twine line run from the boat to the vessel measured 530 feet. tance of the target measured in the same way was 950 feet. When the torpedo hoisted on board it was found that a few threads of eel grass were about the pellers, not enough to interfere with their action, but indicating that the torped been at or near the bottom. In all the trials, unless otherwise stated, the torpedo pointed by the inventor.

Seventh trial.—Vessel at anchor; sea smooth; wind, force 2, on the starboard tide running ebb one-half knot; steam on motor 50 seconds; pressure, 40 p Fired the torpedo at 2 hours 43 minutes 51 seconds; the torpedo immediately peared beneath the surface. The torpedo was pointed between the buoys, but ne left one, to allow for the tide as before; it first appeared between the two buoys beyond the target, and nearest the line of the right buoy. The direction, as above, was excellent; the range, measured as before, was 1,015 feet; the the whole distance was 9.3 statute miles, or 8.4 knots. On examining th eel grass was found about the propeller, as in the previous case. Before this inventor readjusted the diving rudder.

Eighth trial.—Vessel at anchor; sea smooth; wind, force 2, was on the beam; tide, vessel commencing to swing to port with the flood tide; steam 65 seconds; pressure, 40 pounds. The target was abeam at the moment of firing the torpedo was pointed to the right of the right buoy to allow for the tide. On the torpedo disappeared at once beneath the surface; it was seen from the ves minute and 23 seconds later, about midway between the buoys. The direction indicated above, was excellent. The range was not measured, but was, from the port of the members of the Board, about 30 feet greater than on the previous The torpedo, after diving and striking bottom in 5¼ feet of water, rose to the s and ran at a reduced speed for some little distance; the range, however, was from the point at which it was first seen.

Ninth trial.—Vessel under way, going about 10 knots; sea smooth; wind, on the starboard beam; tide running flood directly with the vessel, but not the target bore abeam, and distant about 300 yards at the time of firing; pointed m between the buoys; steam on the motor 60 seconds; pressure of steam, 38 to 39 p On firing, the torpedo disappeared below the surface; it first arose 1 minute a seconds later, passing about 10 feet to the left of the left buoy. McRitchie (yeo and the boatswain's mate were now in charge of the two boats. The torpedo the water in the crest of the bow wave. This was not strong or high, and prod no apparent effect, the torpedo immediately disappearing beneath the surfac before. The direction, as indicated above, was excellent. The range was about same as in the two previous trials.

Tenth trial.—Vessel under full way, making about 10½ knots; sea smooth; running flood with the vessel; wind, force 2, on the starboard beam; steam on motor 60 seconds; pressure of steam, 39 to 37 pounds. Fired the torpedo at angles to the keel, pointing to the right of the right buoy, to allow for the tide. immediately disappeared beneath the surface; it first broke water between the v and the target 70 feet from the target; disappearing again, it passed betwee buoys and rose about 30 feet beyond the line of the buoys. The direction, as in above, was excellent. The range, as estimated, was 500 yards to the target. torpedo lying in the gangway was shipped in the discharging apparatus and ready for turning on steam in 1 minute and 50 seconds.

June 21, the Speedwell steamed to the middle ground between Capes Henry Charles. Anchored two boats, separated by a measured distance of 70 feet, to a target.

Eleventh trial.—Vessel under full way, going about 10½ knots; tide, flood and the course of the torpedo, but not stronger than 1½ knots; depth of water 3 fath target abeam when fired at, and at a distance of about 250 yards; steam was o motor 60 seconds; pressure of steam, 40 to 35 pounds. On firing, the torpedo peared for a very short time, then came to the surface for an instant; and it while on its run, observed to break water in this way four times, running nea surface all the time. Apparently, the torpedo ran much slower than usual. A direction, the torpedo was pointed between the two boats, and it ran about 1 to the right of the right boat. As to range, it was estimated at 260 yards.

Twelfth trial.—As the inventor thought that the torpedo had struck bott last trial at its first plunge, the target (of two anchored boats, as before, 70 fe

ved into 6 fathoms of water. Vessel under full way, going about 10¼ knots; light airs; slack water; steam on motor 60 seconds; pressure of steam, ...unds. At the time of firing the target was broad off the starboard bow at 100 yards distant. Aimed at the space between the boats. The torpedo usual, and then, after just breaking, at a short distance from the vessel, ran ..of about 4 feet between the two boats and about 300 yards beyond before to the surface. As to direction, as indicated above, it was exellent. As to ..nd speed, the torpedo ran about 400 yards in 2 minutes and 5 seconds.

23. the Speedwell went to Newport News and anchored just above the railany's wharves.

..th trial.—Fired at a net, to determine the depth at which the torpedo ran .. the surface. By a misunderstanding, the torpedo was fired before the net an sunk into position below the spar from which it hung. From this fact was no chance for the torpedo to strike the net and thus be possibly injured. ., the torpedo disappeared beneath the surface as usual, but did not reappear, .. lost. Boats were sent to search for it; and the neighboring waters, wharves, ach were thoroughly examined. The Speedwell steamed up and down as near ach as practicable, keeping a sharp lookout for the torpedo. At 5.50 p. m. ..ned the search.

..ause of the loss of the torpedo is unknown to the Board; the case may have ..jured and sunk by leakage; the torpedo may have stuck at the bottom, or ..pedo may have risen to the surface unseen and been swept off by the tide, was running a strong ebb.

..single adjustment of the diving rudder, made after the fourth trial, was the ..djustment of any sort made during all the trials.

torpedo during these trials was dropped from a height of 7 feet above the

APPENDIX I.

..ATE OF MR. H. J. KELLOGG, CIVIL ENGINEER, AS TO THE DISTANCES OF TORPEDO COURSE AT MILFORD, CONN.

MILFORD, CONN., *March* 3, 1884.

..R SIR: I have this day made a survey of the course at Milford, Conn., where .. experiments by Mr. Winsor are being made, and can certify that the distance ..er to outer buoy is one-half mile, and that I have located a buoy half way ..n the said inner and outer buoys.

..Respectfully, yours,

H. J. KELLOGG,
Civil Engineer.

..ain BELKNAP,
President Torpedo Board.

APPENDIX J.

..FICATE OF MR. H. J. KELLOGG, CIVIL ENGINEER, AS TO THE DISTANCES OF TORPEDO COURSE AT MILFORD, CONN.

MILFORD, CONN., *May* 8, 1884.

I hereby certify that I have this day resurveyed the course off Milford, and ..lanted buoys to mark one-eighth, one-quarter, three-eighths, and one-half mile .. on the course.

.. ctfully,

H. J. KELLOGG,
Civil Engineer, Waterbury, Conn.

BELKNAP,
..ted States Navy.

APPENDIX K.

LETTER FROM OFFICE OF DETAIL, INFORMING OF THE DETACHMENT OF LIEUT. COMMANDER T. F. JEWELL AND LIEUT. WASHBURN MAYNARD AS MEMBERS OF THE BOARD, AND THE ORDERING OF LIEUT. COMMANDERS C. F. GOODRICH AND H. E. NICHOLS IN THEIR STEAD.

NAVY DEPARTMENT,
BUREAU OF NAVIGATION AND OFFICE OF DETAIL,
Washington, May 14, 1884.

SIR: You are informed that Lieut. Commander T. F. Jewell and Lieut. W. nard have this day been detached from temporary duty as members of the Bo which you are president and ordered to resume their regular duties at the Torpedo Station.

Lieut. Commanders C. F. Goodrich and H. E. Nichols have been ordered to report to you by letter for temporary duty on the Board in place of the foregoing, detached

By directions of the Secretary.

Respectfully,

J. G. WALKER,
Chief of Bureau.

Capt. G. E. BELKNAP,
Navy-Yard, New York.

APPENDIX L.

CORRESPONDENCE WITH AMERICAN TORPEDO COMPANY.

NAVY-YARD, NORFOLK,
May 21, 1884.

SIR: The Torpedo Board is still waiting to receive the drawings of the torpedo and fittings, together with descriptive texts of the same, of the torpedo belonging to the company which you represent. The Board also desires to be informed if your company propose to go on with the trials of its torpedo at sea, in conformity with the detailed instructions of the Bureau of Ordnance governing the procedure of the Torpedo Board.

Very respectfully, your obedient servant,

GEO. E. BELKNAP,
Captain, United States Navy, and President Torpedo Board.

Mr. WILLIAM A. TORREY,
Agent American Torpedo Company, 32 Warren Street, New York.

AMERICAN TORPEDO COMPANY,
32 WARREN STREET,
New York, May 23, 1884.

SIR: I am in receipt of your letter of 21st instant, to which I hasten to respond.

Permit me respectfully to say that I notified the Bureau of Ordnance (verbally) that it was deemed inadvisable to furnish the Department with the drawings of the torpedo boat, at this time, but that they would be furnished in case of purchase.

The limited time renders it impossible for us to furnish and fit to the steamer Speedwell the necessary complete launching and detaching apparatus for trials at sea.

We much regret this, as we are fully satisfied that the trials of this torpedo at sea would be as satisfactory as those you have already witnessed.

Very respectfully, your obedient servant,

WILLIAM A. TORREY,
General Agent American Torpedo Company.

Capt. GEORGE E. BELKNAP, U. S. N.,
President Torpedo Board, Navy-Yard Norfolk, Va.

UNITED STATES NAVY-YARD, NORFOLK, VA.,
June 13, 1884.

SIR: Will you be good enough to state, for the necessary information of the Naval Torpedo Board, the probable price, with launching apparatus complete, of the torpedo which you represent as general agent?

Very respectfully, your obedient servant,

GEO. E. BELKNAP,
Captain, United States Navy, and President Torpedo Board.

Mr. WILLIAM A. TORREY,
General Agent American Torpedo Company, New York.

AMERICAN TORPEDO COMPANY,
32 WARREN STREET,
New York, June 16, 1884.

SIR: Referring to your letter of 13th instant, just received, I would say that the price of the torpedo boat is $10,000 each, and the probable price of the launching apparatus is about $250 each, the price varying with the size of vessel to which it is to be attached.

Very respectfully, yours,

WILLIAM A. TORREY,
General Agent American Torpedo Company.

Capt. GEORGE BELKNAP,
President Torpedo Board, Norfolk, Va.

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NAVY-YARD, NORFOLK, VA.,
September 22, 1884.

SIR: I have the honor to transmit herewith the report of the Naval Torpedo Board with regard to the Sims electrical fish torpedo brought before it for examination and trial at Willet's Point, N. Y., in July last.

The report has been withheld with a view to the receipt of more information concerning proposed modifications of the torpedo for its better adaptation to naval warfare, but the information finally furnished came in such form as to preclude its incorporation with the report.

The Board begs to acknowledge its obligation for the courtesies received at the hands of Bvt. Brig. Gen. Henry L. Abbot, Corps of Engineers, United States Army, on the occasion of its visit at Willet's Point.

Very respectfully, your obedient servant,

GEO. E. BELKNAP,
Captain, United States Navy, and President of Board.

Hon. WM. E. CHANDLER,
Secretary of the Navy, Navy Department, Washington, D. C.

NEW YORK, *July* 16, 1884.

SIR: In addition to the torpedoes already reported upon under date of June 25 and last, the Board, pursuant to an invitation from the Sims Electric Fish-Torpedo Company, of New York, a copy of which is hereto appended marked A, and by authority of the Department, convened at Willet's Point, New York, on the 15th inst., for the examination and trial of the torpedo presented by the said company.

Bvt. Brig. General Abbot, Corps of Engineers, United States Army, received the Board and assisted the representatives of the company in the exhibition and trial of the torpedo.

A brief description of this torpedo is hereto appended, marked B.

There was but one trial made in the presence of the Board, the record of which, together with the results observed, is given in Appendix C, hereto appended.

The programme of trials as laid out in the instructions of the Bureau of Ordnance to the Board was not carried further than this one smooth-water trial, because the company were not prepared for any others, as the Board was informed by the company's representative.

From the meager data obtained the Board makes the following partial report:

Accuracy: The torpedo is steered by an electric current passing through insulated cables connecting it with the key-board, afloat or ashore. The working of the rudder was prompt and the torpedo obeyed her helm fairly well, but owing to the torpedo's length, large surface, and shape, it was somewhat slow in turning.

Range: Good; one mile of cable fixes the range of this particular torpedo.

Velocity: Poor; approximately 8½ knots.

CERTAINTY OF OPERATION.

a Certainty of launching and starting on its course: The torpedo was lowered from fixed tackles and towed into position. From its construction, however, the operation of launching from a vessel would necessarily be very difficult and awkward.

b Certainty of explosive action on contact with target: Undetermined. Plan for firing "at will" described, which would probably be successful in case operator made no mistake.

Destructiveness: As the charge is subaqueous and large, the destructiveness is probably all that could be desired.

Safety in handling: Measurably safe, but the safety of a torpedo may be regarded as an utterly unknown quantity in a naval combat.

Facility of handling: Very awkward, owing to its length, bulk, and weight.

Simplicity: Fairly simple; the engine and steering compartment is readily dismounted for examination and repair, and readily reassembled. As the power is generated outside, much complexity and many sources of accident are avoided in the torpedo itself.

Ability to be operated with safety from an enemy's fire: Fair. Some exposure unavoidable, but under the conditions of naval warfare to-day, with the enormous powers of defense afforded by machine guns of great range and power, torpedoes of great size, length, and weight would be dangerous to handle under the fire of an enemy. As this torpedo's charge is subaqueous, there would be no danger of its explosion by the enemy's fire after it was once launched.

Simplicity of launching apparatus: None submitted, rendering the torpedo wholly incomplete in that respect.

Efficiency as to launching at an object: See foregoing answer.

QUESTIONS.

Is the torpedo difficult of manufacture?

Not with proper plant.

Is great accuracy of manufacture necessary?

Yes; in the electrical apparatus in the torpedo and on shore and in the cable.

Is great structural strength necessary?

The connection between the float and the torpedo must be stiff and strong.

What effect has the motion of the vessel at sea on the preparation of the torpedo, and on the torpedo itself when in position for firing?

Undetermined.

What effect has the motion of the vessel on the facility of pointing?

Not demonstrated, but in the case of this torpedo there could be none, as the pointing is done after it is launched and clear of the vessel.

Is the preparation of the torpedo for action an elaborate process?

No; on the contrary, simple, except that it is large and heavy and awkward to handle.

Is much care necessary to keep the torpedo in a state for speedy use?

A fair amount of attention, such as would be necessary for any unused

Is the actuating apparatus or material reasonably safe and harml loaded and when in use?

Perfectly safe and harmless.

Does it probably deteriorate or dangerously change with time or with changes of temperature and other conditions incident to service?

No; except that the cable might deteriorate in a warm or unequable climate.

Can the torpedo be rendered innocuous at the end of the flight?

Yes.

Can it be conveniently and safely packed for transportation?

Yes; in parts, but some parts would be bulky.

What is the price with launching apparatus?

Not ascertained.

POINTS CONSIDERED BY THE BOARD.

With the data furnished by a single trial the Board is unprepared to give an exhaustive opinion on this torpedo; it considers that enough has been shown, however, to warrant the following:

1st. It is from its size, shape, and weight cumbersome to stow and very awkw to handle on board ship.

2d. Its lack of speed would probably render it inefficient in combat betw under way. It could be seen and avoided by an enemy of moderate speed.

3d. When operated in a seaway, the combined surfaces of the float and torpedo would probably make it difficult to steer with accuracy.

4th. Although the float is exposed to an enemy's machine-gun fire, it would not probably be injured by such fire.

5th. In the melee of battle the cables would be liable to displacement and fracture and thus render the torpedo uncontrollable and therefore useless.

6th. While this torpedo embodies valuable features for harbor defense where it can be prepared and manipulated from the deck of a monitor or special vessel, the Board considers that its lack of speed makes its utility, even for this purpose, very doubtful.

, in view of these considerations and conclusions, the Board is of opinion torpedo is not adapted to naval warfare.

are, sir, very respectfully, your obedient servants,

GEO. E. BELKNAP,
Captain, United States Navy, and President of Torpedo Board.
E. O. MATTHEWS,
Captain, United States Navy, and Member.
C. F. GOODRICH,
Lieutenant-Commander, United States Navy, and Member.
H. E. NICHOLS,
Lieutenant-Commander, United States Navy, and Member.
A. R. COUDEN,
Lieutenant, United States Navy, and Member.

. E. CHANDLER,
etary of the Navy, Washington, D. C.

APPENDIX A.

TER OF REQUEST FROM SIMS ELECTRICAL FISH-TORPEDO COMPANY.

e Sims Electrical Fish-Torpedo Company, 39 Park Row, New York, U. S. A. W. Scott Sims, superintendent and president; Oscar Marshall, secretary.]

NEW YORK, *June* 18, 1884.

IR: In recognition of the notice received by this company in the matter of orpedoes, suitable for naval use, to take place before you at Norfolk, Va., on 884, we would with respect state that, owing to the expenditure required he special trials which your Board demands, this company is debarred and from making a run of the Sims electrical fish-torpedo as required by your order to compete for the appropriation now available. We would, however, ectfully ask you to consult and examine the public and confidential record ns's inventions as shown in the official reports of Gen. Henry L. Abbot, U. rials and tests made during each year since 1879, at the United States Torion, Willet's Point, New York Harbor, and to give that record due consideraour report to the honorable the Secretary of the Navy. These records are your services through the kindness of Gen. Henry L. Abbot, U. S. A., as per etter.

ld with respect call your attention to the accompanying pamphlet marked tial," and at the same time mention a few features in the Sims electrical at we think make it superior to others, which may not be fully known and d outside of official sources, for this company has purposely avoided newsoriety, thinking that, as torpedo manufacturers deal with governments and he public, its inventions should be given to the consideration of officials ch matters in charge.

s torpedo is the only controllable-movable torpedo propelled by electricity e power conveyed to the torpedo from a dynamo, or generator of electricity, r shipboard.

s is the only one having the motive power at the hand of the operator and under his absolute control. The motive power is not in the torpedo, in e it would be away from the operator, nor is it subject to explosion and dangerous.

tive power of the Sims is unlimited in quantity, never deteriorates, and e torpedo faster at the last of the run, where greater speed is required. e power does not have to be manufactured and stored previous to use, but ed instantaneously when wanted.

ns is noiseless in its movements, there being no sound to attract the attene enemy. It moves some six feet under water, and is therefore completely reach of shot or artillery fire, the float being indestructible (please consult orts of this point as well as to its diving under floating constructions, such cables).

s of one-mile range carries 250 pounds of dynamite, the two-mile some 400 New machinery recently tested shows the transmission of nearly 100 per power than formerly obtained, which will propel the mile torpedo one mile e of about 15-mile speed, and the two mile at a rate of from 12 to 13 miles the whole two miles.

npany, in placing before your honorable Board the official record of Mr. Sims' ould respectfully state that, if compatible with the public services, it would

be pleased to have you witness trial runs at the torpedo station, Willets Point, N. Y. Harbor, and would be pleased to know your pleasure in the matter.

We have the honor to remain, very respectfully, yours,

W. SCOTT SIMS,
President.
OSCAR MARSHALL,
Secretary.

Capt. G. E. BELKNAP, U. S. N.,
President Torpedo Board, Navy-Yard, Norfolk, Va.

APPENDIX B.

DESCRIPTION OF THE SIMS ELECTRICAL FISH-TORPEDO COMPANY'S TORPEDO.

This torpedo is a cylindrical hull of copper, with conical ends, 23 feet long by 18 inches in diameter, made in four sections. These sections are united by means of lock or bayonet joints.

The forward or bow section has a capacity for about 200 pounds of explosive. The second section contains a coil of two-conductor insulated copper cable. The next section to the rear contains a dynamo-electrical machine as a motor. The after section contains the apparatus for controlling the rudder; the rudder and propeller are attached to this section.

This torpedo is supported at a constant depth by means of a copper float, shaped somewhat like a boat with a covered-in deck. The length of this float is 20 feet, and its beam is about 25 inches It is said to contain material of such a nature that it will continue to furnish sufficient buoyancy after being riddled by small-arm, machine-gun, or other similar projectiles. This was stated by Lieutenant-Colonel Abbot, U. S. A., to have been satisfactorily shown after the float had been severely wounded by shrapnel.

The float and torpedo proper are rigidly secured together at each end and amidships by heavy brass braces. At the forward end the brace is inclined at about 45 degrees, and supported from the rear; the intention being that the float shall be driven under any obstruction that is floating, like a boom or raft.

The cable connects the torpedo to the base of operations, and is the medium through which the motive power is transmitted, and through which the torpedo is controlled. The cable is paid out from the center of a carefully laid coil, and to keep it clear of the propeller it is led through a pipe running under and parallel to the bottom of the torpedo to a point just in rear of the propeller. This arrangement for keeping the cable clear of the propeller is not so good as that adopted in the Lay-Haight torpedo, in which the cable is led out through the hollow propeller shaft.

As the currents of electricity employed are strong, the conductors are necessarily large to prevent undue heating in the coil and to keep down the loss due to the electrical resistance; the resulting cable, when two of these conductors are used, as in this case, is very large and heavy, about one-half inch in diameter. It has the merit of considerable strength.

The electrical motor was furnished by the United States Electrical Company under the Weston patents, and is, apparently, of the same type as their D. E. machines. This motor is unsatisfactory, and a new motor from Siemens & Co., London, was shown. This has not yet been tried, but they hope to get better results with it, especially in the direction of increased speed. The armature shaft of the motor is coupled directly to the propeller shaft, making the mechanical arrangements very simple.

The steering is effected by the manipulation of a key-board, which directs electrical currents through appropriate magnets in the torpedo.

The electrical energy for the motor and for the steering was furnished by a Weston D. E. machine, driven by a belt from a stationary engine on the shore.

When at a distance, the position of the torpedo and its heading are shown by two staffs, one at each end of the boat or surface float. These staffs carry small globes during the day and lights at night. The staffs are so arranged that in case the float passes under an obstruction, they will be pressed back into a horizontal position, and after the obstruction is passed they will be raised into the vertical position by the action of springs. This would probably extinguish any lamps used in night work.

This torpedo, from its size and shape, would be extremely awkward to put together and handle on board a vessel. It is proper to state that the company propose to use a smaller, shorter, and lighter torpedo for offensive work from vessels. None of this

type have ever been made, and it is doubtful if any change in this direction, del remains the same, would render this torpedo fairly convenient for ... board ship.

led hereto is a printed description of this torpedo furnished by the company.

Appendix C.

UM OF EXPERIMENTS MADE WITH THE SIMS ELECTRICAL FISH-TORPEDO COMPANY'S TORPEDO IN THE PRESENCE OF THE TORPEDO BOARD.

was but one trial of this torpedo made in the presence of the Board. This ...ok place at Willets Point, Long Island, the torpedo station of the Army, July

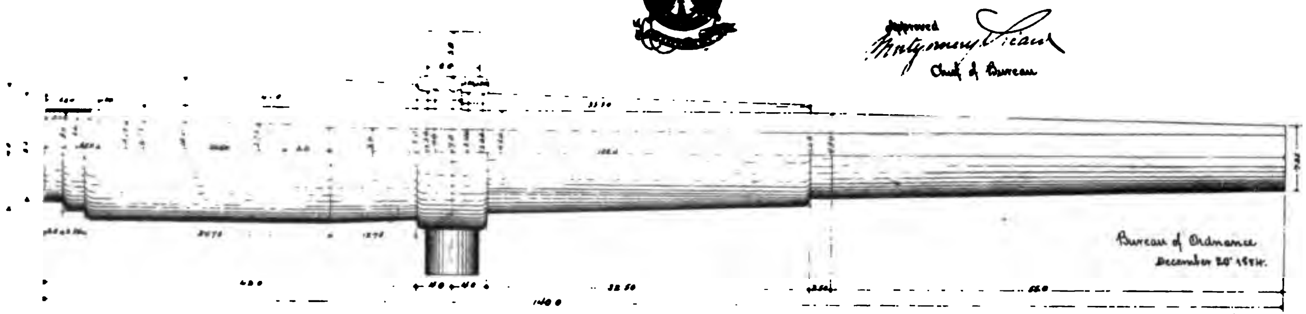
worked the key-board, and enlisted men of the Engineer battalion did the ... ...or necessary in putting the torpedo together, getting it ready and into the ... The D. E. machine for furnishing power was located with its steam en... boiler in a suitable house at a distance of about 500 yards from the key-board t of departure of the torpedo.

... do was in a boat-house, hung in chain slings over the water. The rear com... detached previous to the arrival of the Board, so that the mechanism ...pelling and steering apparatus could be seen, as well as the method adopted ...ing the different parts of the hull together. The torpedo was readily and ... prepared for a run, all the work being done by the soldiers under the direc... a sergeant. The torpedo was lowered into the water and towed clear of ob... near the boat-house; then the dynamo machine on shore having been ... obedience to a signal from the dock, by manipulation of the key-board, current was turned on to the motor in the torpedo, the propellers began ..., and the torpedo promptly started off at a speed of about 8 knots. The ...do was ...ered out into the channel and manœuvered in various directions, and ... back into the vicinity of the starting point, when the dynamo on ...ing been stopped by signal, the torpedo also stopped and remained floating wharf anchored by its cable. There was no opportunity of determining the ...ut it was estimated at 8½ knots per hour. The helm was answered promptly, ... length of the torpedo it turned on a large diameter and rather slowly; ... times and diameters of turning were not determined, but the impression ... was as stated above.

at was readily seen at all times with the naked eye, but it was not easy to ... signal balls which indicate the direction in which the torpedo is head... n the torpedo is at a distance of a half a mile or even less.

5 in. 26 cal. B.L.R.

WEIGHT - 4200 LBS



5 in. 30 cal. B.L.R.

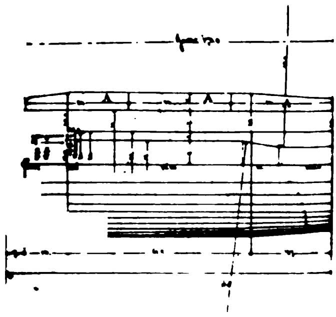
WEIGHT — 5800 LBS

1

STANDARD

12" HOOPED B-L-R

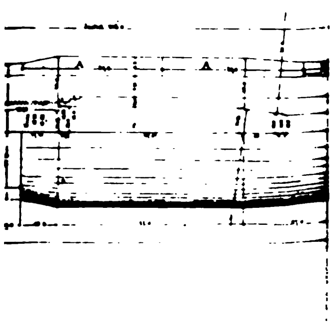
(WEIGHT 44 TONS)



STANDARD

10" HOOPED B-L-R

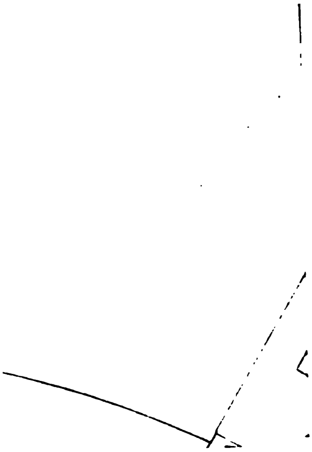
WEIGHT 64000 lbs



STANDARD

10" HOOPED B-L-R.

WEIGHT 53000 lbs



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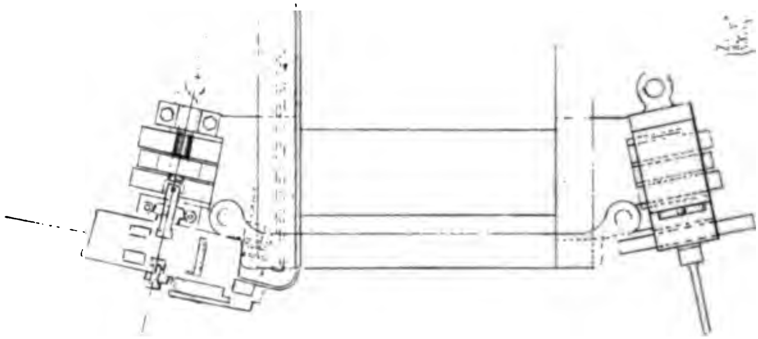
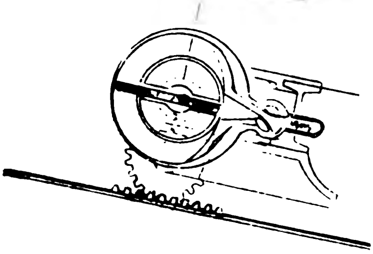
ARRIAGE

F. R





ROTARY FLUID ENGINE.

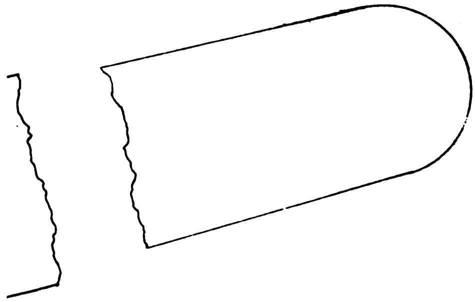
FOR TRAINING **GUN CARRIAGES.**

(Engine standing vertically near training truck)

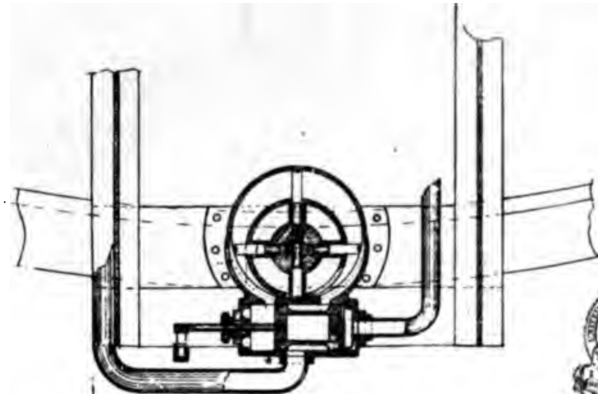
Ordnance Department.

Navy Yard, Washington

Approved Montgomery Sicard Chief of Bureau Feb 3rd 188[illegible].



au of Ordnance
Dec: 3d 1884

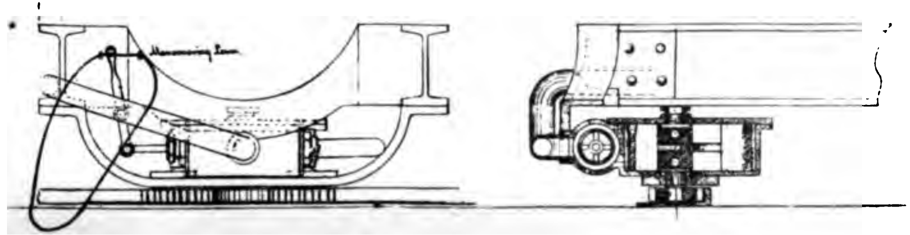


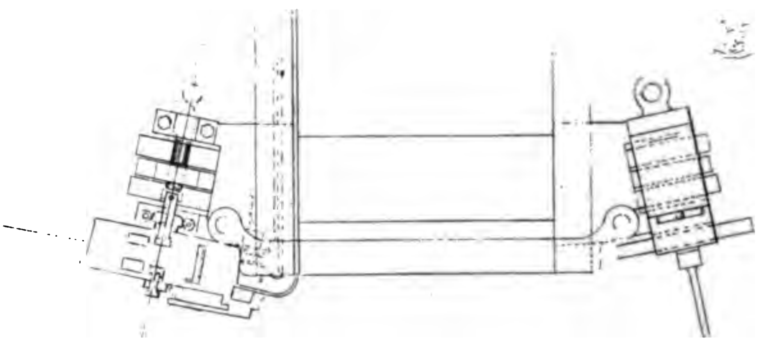
ROTARY FLUID ENGINE
for
TRAINING GUN CARRIAGES.

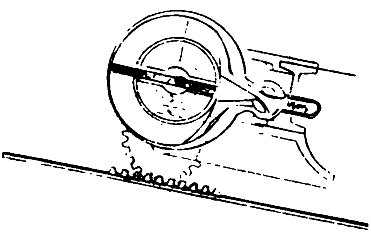
Ord. Dep. W. N. Y.
Jan. 25. 1883

Cylinder near Engine horizontal
Training pinion gearing into third on
front edge of rack

Approved Montgomery Sicard
Chief of Bureau







ROTARY FLUID ENGINE.

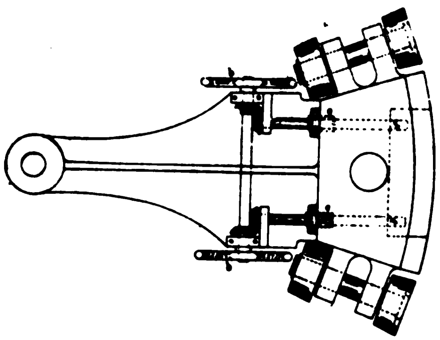
FOR TRAINING **GUN CARRIAGES.**

(Engine standing vertically near training truck)

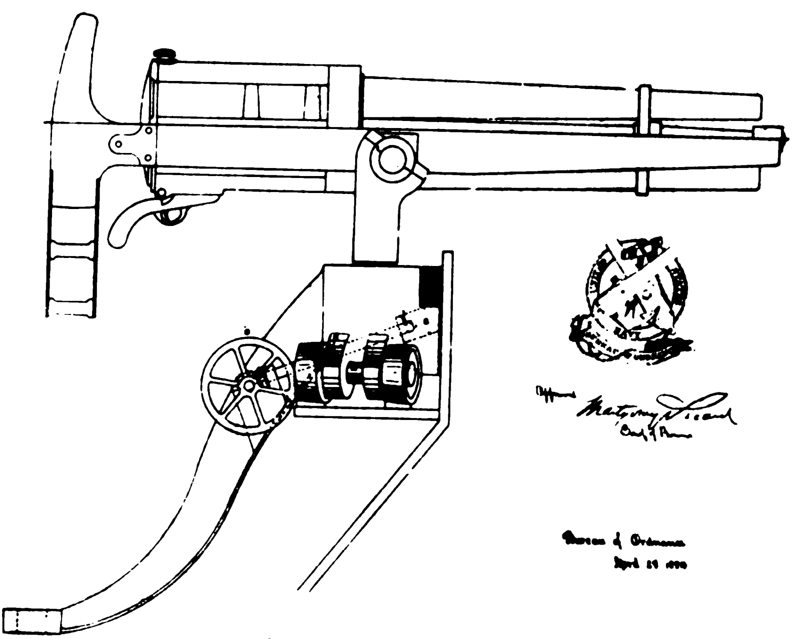
Ordnance Department.

Navy Yard, Washington

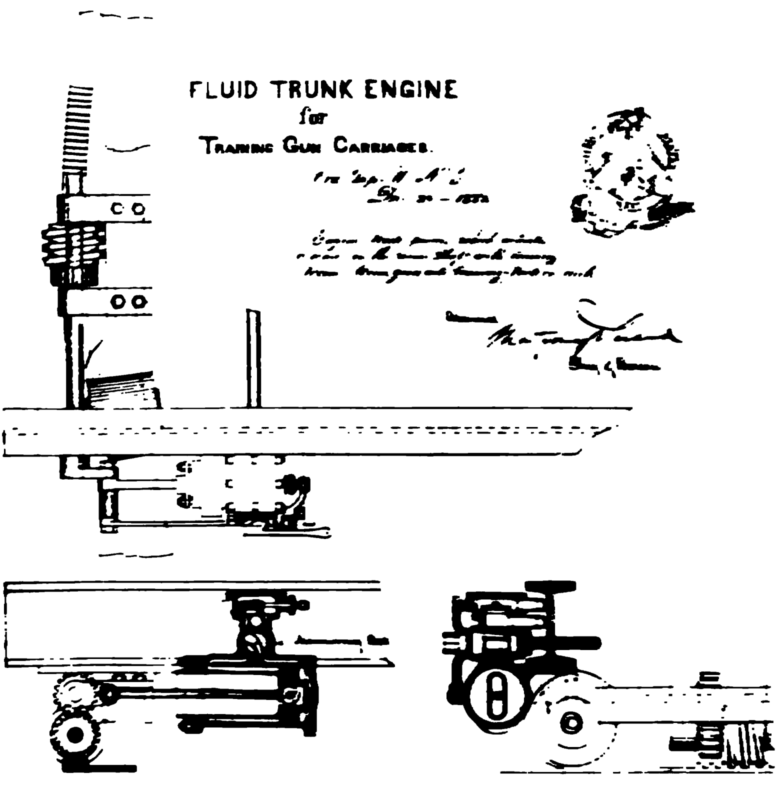
Approved Montgomery Sicard Chief of Bureau Feb 3rd 188[illegible].



CAST STEEL
TOWER MOUNT
FOR
HOTCHKISS REV. CAN.



Bureau of Ordnance


FLUID TRUNK ENGINE
for
TRAINING GUN CARRIAGES.

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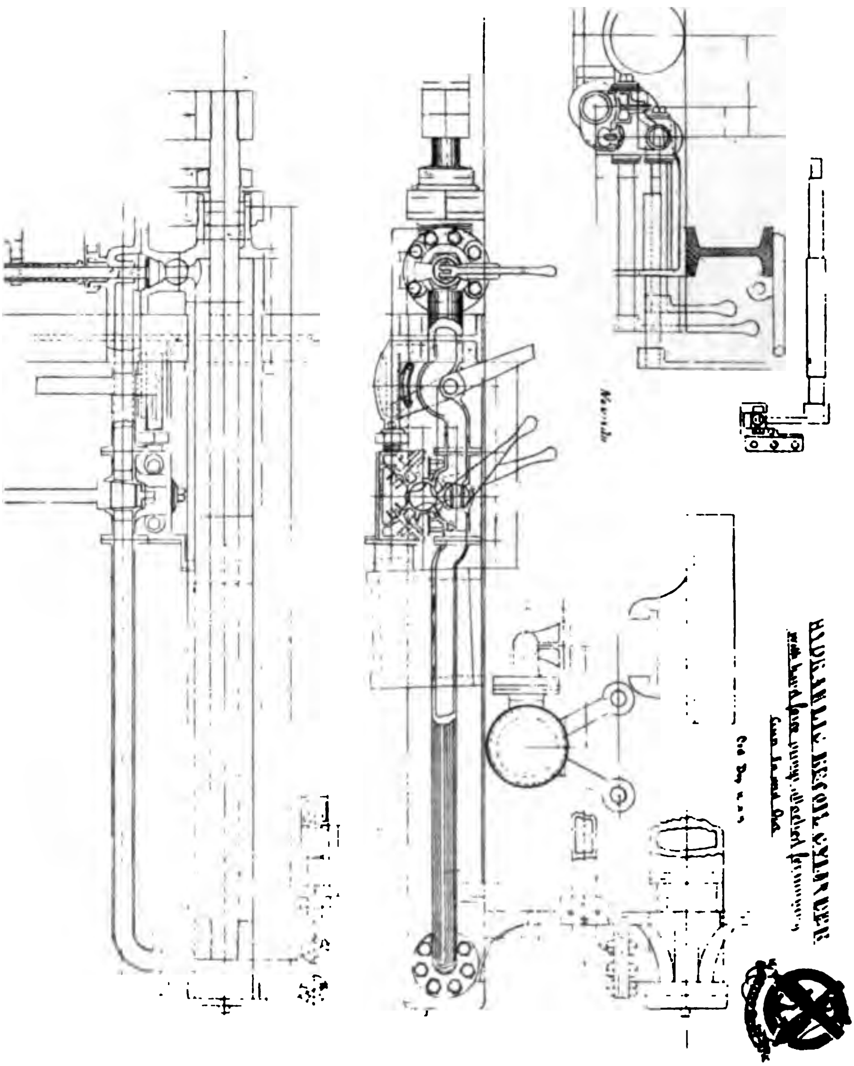
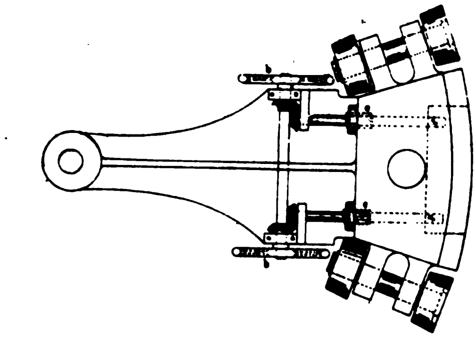
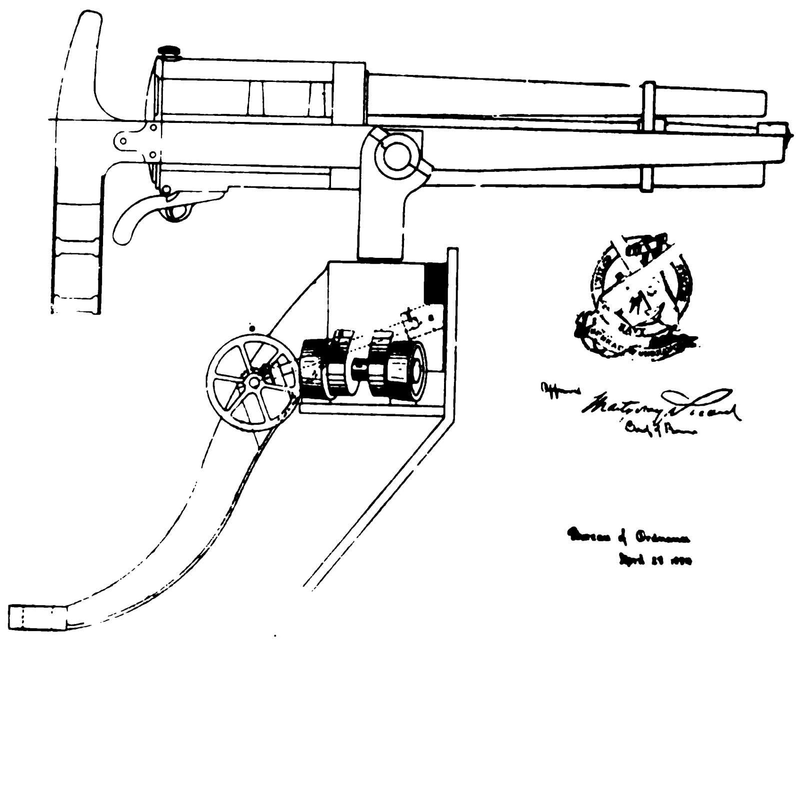

HYDRAULIC RECOIL CYLINDER



CAST STEEL
TOWER MOUNT
FOR
HOTCHKISS REV. CAN.

a. clamp
b. hand wheel for working clamp
c. screw to prevent clamp from backing



Approved Montgomery Sicard
Chief of Bureau

Bureau of Ordnance
April [illegible]

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